

A SYNOPSIS OF THE RECENT AND TERTIARY FRESHWATER  
MOLLUSCA OF THE CALIFORNIAN PROVINCE, BASED UPON  
AN ONTOGENETIC CLASSIFICATION.

(Concluded from p. 165.)

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PLATES VII-VIII.

Superfamily MELANOIDEÆ (Swainson), 1840.

THE Melanoideæ include several families of cerithiform operculates inhabiting the marine littoral zone, estuaries, amphibious situations near the sea, and purely fresh waters, among which may be noted the Melaniidæ, Swainson, 1840, Turritellidæ, H. & A. Adams, 1854, Cerithiidæ, H. & A. Adams, 1854, Melanopsidæ (H. & A. Adams), 1854, Pleuroceridæ, Fischer, 1887, and Ellipstomidæ, n.fam. In few other groups of Gastropods is the classification more involved than among the brackish and freshwater Melanoids; species but distantly related so closely resemble one another that the only safe criterion by which to distinguish them lies in the anatomy. Even in the following family, however, represented in fully two-thirds of the streams of the United States, the internal characters have not been sufficiently described to offer a clue to what constitutes generic differences.

Family PLEUROCERIDÆ, Fischer, 1887.

Shell of variable size, fusiform or conical, covered with a greenish or tawny epidermis frequently marked by darker spiral bands, whorls more or less appressed, sutures but little impressed, aperture in its simplest form normal, the outer lip sinuate, slightly retracted and produced below, in the more specialized forms with an elongate fusiform canal or sutural pleurotomariform cleft; animal oviparous, mantle-margin simple, operculum horny and concentric; habitat chiefly fluviatile.

Two stages or sub-families depending chiefly on the modification of the aperture are recognizable as follows:—

Sub-family PLEUROCERINÆ, s.s.

Shell melaniform, periphery generally smooth and rounded, aperture simple, the outer lip sinuate, slightly retracted and produced below.

Genera, *Pleurocera*, s.s., *Ambloxus*, *Gyrotoma*, sub-gen. *Goniobasis*.

Sub-family GYROTOMINÆ, n.sub-fam.

Shell not typically melaniform, whorls more or less peripherally carinate and nodose or nodose-spinous, aperture produced below into a fusiform canal, or retracted above into a sutural cleft; *Pleurocerina* stage passed during adolescence.

Genera, *Gyrotoma*, s.s., *Pleurocera*, sub-gen. *Io*.

Through the efforts of Rafinesque, Lea, Haldeman, Anthony, and the Adams during the early and middle parts of the last century the classification of this family has been so burdened with unreduced specific synonyms and a superabundance of genera that no subsequent writer has cared to undertake its thorough revision, while but two, Tryon<sup>1</sup> and Pilsbry,<sup>2</sup> have given serious attention to the group since that time.

In an endeavour to straighten out the involved generic nomenclature of the Western forms the recent members of the entire family have been reviewed, and from among the hundreds of nominal species nine species and four sub-species, representing three genera, have been selected as entitled to serious consideration.<sup>3</sup>

It is not anticipated that this treatment will meet with general approval in every instance. In the absence of a field acquaintance with the species from east of the Rocky Mountains (the family is restricted to the Nearctic Region, and chiefly to the Mississippi Valley), and the necessity of depending on figures, locotypes, and named specimens, certain errors are bound to creep in. If, however, the way is paved for a thorough revision, the mission of these pages will have been fulfilled. To assist in this types have been cited for all the group names current in the literature, without, however,

<sup>1</sup> Strepomatidæ, *Smith. Misc. Coll.*, No. 253, 1873.

<sup>2</sup> In Pilsbry & Rhodes, *Proc. Philad. Acad. Nat. Sci.*, 1896, pp. 495 ff.

<sup>3</sup> The genus *Ellipstoma* (+ *Anculosa*, Say), ordinarily included in this family, in reality groups by itself in the Ellipstomidæ, nov. The species (if there is more than one with several sub-species) are wholly confined to the waters east of the Mississippi River, and hardly concern us here. The following is a summary of the generic arrangement:—

Genus ELLIPSTOMA, Rafinesque.

*Ellipstoma*, Rafinesque, 1818 (*E. gibbosa*, Raf.); *Lithasia*, Haldeman, 1840 (*Anculosa* (*Lithasia*) *genicula*, Hald. = *E. gibbosa*, Raf.).

Type, *Ellipstoma gibbosa*, Rafinesque.

Sub-genus ANCULOSA, Say.

*Leptoxis*, Rafinesque, 1818 (no species cited, description apparently based on *prærosa*); *Anculosa*, Say, 1821 (*Melania* (*Anculosa*) *prærosa*, Say); *Anculotus*, Say, 1825 (emended form); *Leptoxis*, 'Rafinesque,' Haldeman, 1847 (*L. retusa*, Raf. = ? *A. prærosa*, Say); *Euryæalon*, Lea, 1864 (*Goniobasis* (*Euryæalon*) *umbonatum*, Lea = *A. prærosa*, Say).

Type, *Melania* (*Anculosa*) *prærosa*, Say.

Sub-genus MUDALIA, Haldeman.

*Bulimus* (sp.), Bruguière, 1792 (*B. carinatus*, Brug.); *Paludina* (sp.), Say, 1819 (*P. dissimilis*, Say = *B. carinatus*, Brug.); *Mudalia*, Haldeman, 1840 (*P. dissimilis*, Say = *B. carinatus*, Brug.); *Nitocris*, H. & A. Adams, 1854 (*Anculosa carinata*, Lea = *B. carinatus*, Brug., first species); *Spirodon*, 'Anthony MS.,' Tryon, 1873 (*A. monodontoïdes*, Conr. = *B. carinatus*, Brug.), in synonymy.

Type, *Bulimus carinatus*, Bruguière.

The genetic relations of these three are in reverse order. *Mudalia* represents the most primitive, and *Ellipstoma* the most highly modified stage.

interposing unnecessary changes in the existing nomenclature, thus eliminating them as possibilities for future disturbance. One of the most knotty problems has been the recognition of Rafinesque's genera. The English language is not forceful enough to adequately express the feeling of the systematist who has to judge these crimes in the name of science.

### Genus PLEUROCERA, Rafinesque.

*Pleurocera*, Rafinesque, 1818, 1819 (generic diagnosis only); *Pleurocera*, Rafinesque, 1820 (*P. verrucosa*, Raf.); *Melania* (sp.), Say, 1821 (*M. canaliculata*, Say); *Telescopella*, Gray, 1837 (*M. undulata*, Say = *canaliculata*, Say); *Ceriphasia*, Swainson, 1840 (*C. sulcata*, Swains. = *M. canaliculata*, Say); *Angitremu*, Haldeman, 1841 (*M. armigera*, Say); *Elimia* (sp.), H. & A. Adams, 1854 (*M. elevata*, Say = *canaliculata*, Say); *Megara* (pars), H. & A. Adams, 1854 (*M. lima*, Conr. = *P. verrucosa*, Raf.); *Streptobasis*, Lea, 1861 (*S. Spillmanii*, Lea = *M. bitaniata*, Conr.); *Tryphanostoma*, Lea, 1862 (*M. canaliculata*, Say); *Strepoma*, 'Rafinesque MS.,' Haldeman, 1863 (*Ceriphasia sulcata*, Swains. = *M. canaliculata*, Say, by substitution); *Meseschiza*, Lea, 1864 (*M. Grosvenorii*, Lea = *M. armigera*, Say, deformed).

Type, *Pleurocera verrucosa*, Rafinesque.<sup>1</sup>

<sup>1</sup> No type species has ever been cited for *Pleurocera* so far as the writer has been able to determine. Tryon, Fischer, and Pilsbry appear to have regarded *Melania canaliculata*, Say (not described till 1821), as typical, but do not identify it with any of Rafinesque's species. Rafinesque first described the genus in 1818 in the *American Monthly Magazine and Critical Review*, and repeated the diagnosis in a somewhat altered form in the *Journal de Physique* for 1819. Six species were named in the former instance, but it does not appear that they ever passed the *nomen nudum* stage. The generic description, with a little imagination, would fit any member of this section of the family about equally well, so that nothing can be gained from that. In the *Annals of Nature*, i, p. 11, 1820, Rafinesque described *Pleurocera verrucosa*, and mentioned that the genus had been diagnosed in the *Journal de Physique*. Tryon says in regard to this species: "With no disposition to give place to the description of Mr. Rafinesque, at the expense of naturalists of honesty and reputation, I am still constrained, in this instance, to quote his name for the shell that is so well known amongst us as Mr. Say's *nupera*. Indeed, I cannot find any description of a species of shell, by Rafinesque, which indicates so unmistakably the shell intended by him, as does the one here quoted. It may be mentioned, not as proof in itself, but merely as collateral evidence of the correctness of my views of this species, that in a manuscript by Rafinesque, entitled *Conchologia Ohioensis*, belonging to the Smithsonian Institution, a rough pen sketch of *Pleurocera verrucosa* is given, which is a very good representation of Mr. Say's *nupera*." *Pleurocera* must therefore be dated from 1820, with *P. verrucosa* as the monotype.

That Rafinesque's group was probably no more homogeneous than the later divisions of the Adams and Lea, may be judged from the fact that in 1831 three more species were added, of which *P. gonula*, probably, and *P. quadrosa* certainly are referable to *canaliculata*, while *P. acuta* is doubtless *Ambloxyus virginicum*.

Sub-genus *Io* (Lea).

? *Oxytrema*, Rafinesque, 1819 (no type cited, description appears to have been based on smooth form of *fluviatilis*); *Fusus* (sp.), Say, 1823 (*F. fluviatilis*, Say); *Io*, Lea, 1832 (*I. fusiformis*, Lea = *F. fluviatilis*, Say); *Melafusus*, Swainson, 1840 (no species cited, description apparently based on *fluviatilis*).

Type, *Fusus fluviatilis*, Say.

Sub-genus *Pleurocera*, s.s. Shell of rather large size, averaging 30 mm. in altitude, solid, spire elevated-conic, early whorls normally smooth and rounded, adult whorls barely inflated or appressed, frequently more or less nodose on the periphery, which has a tendency to become sub-carinate, aperture simple, pillar straight and imperforate, outer lip sinuate, somewhat produced and channelled below; habitat streams.

Sub-genus *Io*. Shell similar to preceding but larger, averaging 40 mm. in altitude, moderately thin, spire elevated-conic, whorls barely inflated or appressed, periphery sub-carinate and more or less ornamented with nodes which increase in size and complexity with the later growth tending to acquire the character of spines, imperforate, outer lip deeply sinuate, and produced below into a fusiform canal; *Pleurocera* stage passed during adolescence; habitat in streams.

*Pleurocera* includes the usually peripherally nodose, straight-pillared, more or less conical American Melanoids, the canalled forms composing the sub-genus *Io*. A somewhat anomalous state of affairs exists, but one to be expected in the history of all genera, in that all the *Ios* are represented by sub-species in typical *Pleurocera*.

## PLEUROCERA VERRUCOSA, Rafinesque.

*P. verrucosa*, Rafinesque, 1820; *Melania nupera*, Say, 1829; *Melanopsis semigranulosa*, Deshayes, 1830; *M. lima*, Conrad, 1834; *M. Hydei*, Conrad, 1834; *M. Florentiana*, Lea, 1841; *M. fuliginosa*, Lea, 1841; *M. venusta*, Lea, 1841; *M. Holstonia*, Lea, 1841; *Lithasia dilatata*, Lea, 1841.

Shell of moderate size, broadly conical, whorls barely inflated, periphery rounded, early volutions smooth, penultimate and body-whorls with about five rows of tubercles, the fourth row peripheral, aperture elliptical and somewhat produced below, outer lip sub-sinuate and channelled at base; habitat streams.

Holston, Tennessee, and lower Ohio Rivers, American Province.

## PLEUROCERA CANALICULATUM, Say.

*Melania canaliculata*, Say, 1821; *M. conica*, Say, 1821 (preoce.); *M. Sayi*, Wood, 1828; *M. undulata*, Say, 1829; *M. exarata*, Menke, 1830; *M. ligata*, Menke, 1830; *M. auriscalpium*, Menke, 1830; *Pleurocera quadrosa*, Rafinesque, 1831; *M. alvearis*, Conrad, 1834; *M. annulifera*, Conrad, 1834; *M. excurtata*, Conrad, 1834; *M. prasinata*, Conrad, 1834; *M. pyrcnellum*, Conrad, 1834; *Ceriphasia sulcata*, Swainson, 1840; *M. substricta*, Haldeman, 1840; *M. 'nupera*, Say', Say, 1840 (*purs*);



*M. regularis*, Lea, 1841; *M. exarata*, Lea, 1841 (preocc.); *M. turgida*, Lea, 1841; *M. arata*, Lea, 1841; *M. producta*, Lea, 1842; *M. Foremanii*, Lea, 1842; *M. curvatum*, Lea, 1842; *M. torquata*, Lea, 1842; *M. Ordiana*, Lea, 1842; *M. torta*, Lea, 1842; *M. filum*, Lea, 1845; *M. pernodosa*, Lea, 1845; *M. Brumbyi*, Lea, 1852; *M. gradata*, Anthony, 1854; *M. planogyrum*, Anthony, 1854; *M. eximia*, Anthony, 1854; *M. glans*, Anthony, 1854 (preocc.); *M. incrassa*, Anthony, 1854; *M. fastigiata*, Anthony, 1854; *M. opaca*, Anthony, 1860; *M. ponderosa*, Anthony, 1860; *M. grossa*, Anthony, 1860; *M. infrafusciata*, Anthony, 1860; *M. glandula*, Anthony, 1860; *M. iostoma*, Anthony, 1860; *M. nigrostoma*, 'Anth. MS.,' Reeve, 1860; *M. rorata*, Reeve, 1860; *Io gracilis*, Lea, 1861; *I. robusta*, Lea, 1861; *I. viridula*, Lea, 1861; *Tryphanostoma dux*, Lea, 1862; *T. Troostii*, Lea, 1862; *T. viride*, Lea, 1862; *T. ligatum*, Lea, 1862; *T. Showalterii*, Lea, 1862; *T. Thorntonii*, Lea, 1862; *T. trivittatum*, Lea, 1862; *T. Postellii*, Lea, 1862; *T. incurvum*, Lea, 1862; *T. Alabamense*, Lea, 1862; *T. Florencense*, Lea, 1862; *T. olivaceum*, Lea, 1862; *T. simplex*, Lea, 1862; *T. canalitium*, Lea, 1862; *T. Clarkii*, Lea, 1862; *T. Anthonyi*, Lea, 1862; *T. moriforme*, Lea, 1862; *T. Pybasii*, Lea, 1862; *T. Jayi*, Lea, 1862; *T. Hartmanii*, Lea, 1862; *T. bivittatum*, Lea, 1862; *T. Spillmanii*, Lea, 1862; *T. tortum*, Lea, 1862; *T. Tennesseeense*, Lea, 1862; *T. minor*, Lea, 1862; *T. dignum*, Lea, 1862; *T. moniliferum*, Lea, 1862; *T. trochulus*, Lea, 1862; *T. pumilium*, Lea, 1862; *T. Christyi*, Lea, 1862; *T. Tuomeyi*, Lea, 1862; *T. labiatum*, Lea, 1862; *T. Lewisii*, Lea, 1862; *T. curtatum*, Lea, 1863; *P. plicatum*, Tryon, 1863; *T. Roanense*, Lea, 1864; *T. Lesleyi*, Lea, 1864; *T. univittatum*, Lea, 1864; *T. subrobustum*, Lea, 1864; *T. cinctum*, Lea, 1864; *T. cylindraceum*, Lea, 1864; *T. napoideum*, Lea, 1864; *T. affine*, Lea, 1864; *P. Leaii*, Tryon, 1873; *P. Parkerii*, Tryon, 1873.

Shell large, rather broadly conical, whorls closely appressed, sutures not impressed, periphery sub-rounded or angular, aperture elliptical and more or less produced below, the outer lip sinuate and channelled at base; habitat chiefly streams.

Ohio, Tennessee, and Alabama River Systems, American Province.

#### PLEUROCERA FLUVIATILIS ARMIGERA (Say).

*Melania armigera*, Say, 1821; *M. stygia*, Say, 1829; *M. tuberculata*, Lea, 1830 (preocc.); *M. Duttoniana*, Lea, 1841; *M. Jayana*, Lea, 1841; *M. Spiziana*, Lea, 1848; *M. robulina*, Anthony, 1850; *Io rota*, Reeve, 1860; *L. fasciolata*, Reeve, 1860; *M. nodata*, Reeve, 1860; *Angitrema Wheatleyi*, Tryon, 1866.

Shell of moderate size, broadly conical, whorls appressed, periphery subangular and more or less nodose on body-whorl, aperture elliptical and slightly produced below, outer lip barely sinuate and channelled at base; habitat streams.

Cumberland, Wabash, and lower Tennessee Rivers, Alabama, American Province.

## PLEUROCERA BITENIATA (Conrad).

*Melania biteniata*, Conrad, 1834; *M. curta*, Haldeman, 1841; *M. pumilia*, Lea, 1845; *M. solida*, Lea, 1845 (preocc.); *M. corpulenta*, Anthony, 1854; *Streptobasis Spillmanni*, Lea, 1861; *S. cornea*, Lea, 1861; *S. Clarkii*, Lea, 1861; *S. olivaria*, Lea, 1862; *S. carinata*, Lea, 1862; *S. Lyonii*, Lea, 1864.

Shell of moderate size, conic-subpupiform, whorls appressed, compressed, and somewhat concave above the sub-rounded periphery, aperture sub-elliptical, narrowing above, columella callused, outer lip sinuate and channelled at base; habitat streams.

Tennessee and Alabama Rivers, American Province.

## PLEUROCERA SOLIDA (Lea).

*Anculosa solida*, Lea, 1842; *Melania brevis*, Lea, 1842; *Lithasia Showaltherii*, Lea, 1850; *M. compacta*, Anthony, 1857; *L. nuclea*, Lea, 1860; *M. trivittata*, Reeve, 1860; *L. fusiformis*, Lea, 1861; *L. vittata*, Lea, 1862; *L. Downii*, Lea, 1862.

Shell similar to preceding but more slender-conic, whorls appressed and slightly shouldered at periphery, aperture narrowly elliptical and produced above and below, columella not heavily callused, outer lip but slightly sinuate and not prominently channelled at base; habitat streams.

Coosa and ? Cumberland Rivers, Alabama, American Province.

Tryon has written *solida* as a synonym of *brevis*, described by Lea on a preceding page of the same article. He says, however: "Mr. Reeve has not recognized the genus *Lithasia*, and accordingly changes the name (i.e. *brevis*) to *trivittata*, Reeve, because Mr. Lea had already used *brevis* for a Melanian." Reeve's monograph has not been at hand to verify Tryon's statement, and there is no record in Seudder's Index that Lea described more than the one *Melania brevis*. Owing, however, to the enormous number of specific names used under *Melania* it is not unlikely that *brevis* is preoccupied several times. Until the classification is thoroughly cleared up it seems preferable to write *solida*.

## PLEUROCERA (Io) FLUVIATILIS (Say).

*Fusus fluviatilis*, Say, 1825; *Io fusiformis*, Lea, 1831; *I. spinosa*, Lea, 1834; *I. tenebrosa*, Lea, 1834; *I. brevis*, Anthony, 1860; *I. spirostoma*, Anthony, 1860; *I. turrita*, Anthony, 1860; *I. inermis*, Anthony, 1860; *I. verrucosa*, Reeve, 1860 (preocc.); *I. lurida*, 'Anth. MS.,' Reeve, 1860; *I. gibbosa*, 'Anth. MS.,' Reeve, 1860; *I. rhombica*, 'Anth. MS.,' Reeve, 1860; *I. recta*, 'Anth. MS.,' Reeve, 1860.

Shell of large size, broadly conical, the mid-adolescent whorls subangular at periphery, and more or less ornamented with nodes which increase in size and complexity on the later volutions, developing on the body-whorl into hollow spines, aperture broadly elliptical and very much produced below, the canal nearly equal in length to the spire; *armigera* stage completed during early adolescence; habitat streams.

Tennessee River and tributaries above Jackson County, Alabama (*vide* Jas. Lewis), American Province.

Apparently a northern sub-species of *armigera*.

PLEUROCERA (Io) CANALICULATUM NOBILE (Lea).

*Melania nobilis*, Lea, 1845; *Io Spillmanni*, Lea, 1861; *I. variabilis*, Lea, 1861; *I. nodosa*, Lea, 1861; *I. modesta*, Lea, 1861.

Shell similar to *canaliculatum* but larger, a sub-carinate nodose periphery developed on the body-whorl, aperture produced into a short gyrate canal; *canaliculatum* stage passed during late adolescence; habitat streams.

Little Tennessee and Tennessee Rivers, Alabama, American Province.

A poorly marked southern race of *canaliculatum*.

Genus AMBLOXUS (Rafinesque).<sup>1</sup>

*Buccinum* (sp.), Gmelin, 1788 (*B. Virginicum*, Gmel.); *Paludina* (sp.), Say, 1819 (*B. Virginicum*, Gmel.); *Melania* (sp.), Say, 1824 (*B. Virginicum*, Gmel.); *Ambloxus*, Rafinesque, 1831 (*Melania* (*Ambloxus*) *rugosa*, Raf. = *B. Virginicum*, Gmel.); *Hemisinus* (sp.), H. & A. Adams, 1854 (*M. bulbosa*, Gld. = *M. plicifera*, Lea); *Pachycheilus* (*Pachychilus*, Lea, em.) (sp.), H. & A. Adams, 1854 (*M. simplex*, Say = *B. Virginicum*, Gmel.); *Potadoma* (sp.), H. & A. Adams, 1854 (*M. depygis*, Say = *B. Virginicum*, Gmel.); *Elinia*

<sup>1</sup> While no mention of previous publications is made, it would appear at first glance that *Ambloxus*, Rafinesque, 1831, is a *lapsus* for *Ambloxis*, Rafinesque, 1818, under which two species, *A. eburnea* and *A. ventricosa*, were named but not described. However, it would take a deal of imagination—more than the writer possesses—to fit one of the slender Pleurocerids described in 1831 to the diagnosis of *Ambloxis*, 1818, which was doubtless intended for some Viviparoid. This is borne out by the fact that in 1865 Binney, in the third part of his *Land and Freshwater Shells of North America*, figured *Ambloxis major* or *Lymnaea eburnea* and *Lymnula ventricosa* from Rafinesque's manuscript, referring them to *Melantho* (= *Campeloma*) *decisa* as synonyms. Rafinesque must be credited with a considerable amount of acumen in recognizing genera; his groups for homogeneity were fully up to the standard of the time and in this family about equal to any work that has ever been done. It seems unreasonable, therefore, to accuse him of referring a vertically plaited syntonic form of *Buccinum Virginicum*, Gmel., to a genus of Lioplacidae. Rafinesque has *Ambloema*, *Amblostrema*, *Ambloplacoda*, *Ambloxis*, and, according to Binney, *Amblostoma*, so that *Ambloxus* is evidently another formed on the same favourite plan, though it is unfortunate that he ran out of desirable etymological combinations of *acutus* before this was named. The confusion of these two is merely the outcome of the notorious carelessness of this author in his writings, but cannot affect the status of *Ambloxus*, 1831, which was given to include two species, of which the first is certainly recognizable and the second doubtfully so. *Ambloxus* and *Ambloxis* are sufficiently distinct to stand side by side nomenclaturally, but occurring as they do in allied groups from the same region there is opportunity for confusion on that score. However, *Ambloxis*, Rafinesque, 1818, has no status, and *Ambloxis*, 'Rafinesque,' Binney, 1865, stands as a synonym of *Campeloma*, leaving the field clear for *Ambloxus*, Rafinesque, 1831.

(pars), H. & A. Adams, 1854 (*M. acuticarinata* (error for *acutocarinata*), Lea = *B. Virginicum*, Gmel.); *Melasma*, H. & A. Adams, 1854 (*Melania blanda*, Lea = *B. Virginicum*, Gmel.); *Juga*, H. & A. Adams, 1854 (*B. Virginicum*, Gmel.); *Tryphanostoma* (sp.), Lea, 1862 (*T. Knoxvilleense*, Lea = *B. Virginicum*, Gmel.); *Goniobasis* (sp.), Lea, 1862 (*G. Draytonii*, Lea = *M. plicifera*, Lea).

Type, *Buccinum Virginicum*, Gmelin.

Shell of moderate size, averaging 25 mm. in altitude, sub-solid, spire attenuate, whorls normally barely rounded or slightly incurved between the suture and the rounded periphery, aperture simple, the pillar curved and imperforate, outer lip sinuate and somewhat produced below; habitat lakes and streams, occupying a wider variety of situations than any other genus in this family.

*Ambloxus* includes the fusiform Pleurocerids, the last genus of the family to be definitely separated from the Lamarckian *Melania*, and hence one which has suffered considerable nomenclatural vicissitude.

None of the species are known to have specialized up to the stage corresponding to *lo* in the preceding genus, or *Gyrotoma*, s.s., in the one to follow. The members of this group are very similar, and not always easy to separate, but with the exception of the Eocene *tenerus* and the recent *Virginicus* all seem sufficiently distinct. Normally each is smooth, but malleated, axially plicate, suturally carinate, peripherally carinate, multicarinate, and spirally frilled forms or types embodying a combination of two or more of these characters apparently occur in every species. These are unquestionably of the nature of syntonic modifications, but, in contrast to other groups so affected, the early growth appears to be the most frequently and seriously deformed, the distortion prevailing in the adult condition only in extreme instances. The philosophy of this is not entirely understood, but it is probable that the stage preceding the present adult stage was a sculptured one, and certain atavistic tendencies are so influenced that the shell assumes bizarre forms.

The synonymy of *A. Virginicus* in spite of its length has been given in full in order to suggest the vast multiplicity of forms that may be expected in a rampantly susceptible species, distributed over a wide area and naturally exposed to many influences. While probably by no means complete, it is yet a striking testimonial of how the American Melanoids should not be classified. Since the bulk of the synonyms are based on syntonic forms, for brevity a few of the better-known normal forms are so noted.

#### AMBLOXUS VIRGINICUS (Gmelin).

*Buccinum Virginicum*, Gmelin, 1788 (normal); *Melania carinifera*, Lamarck, 1801; *M. elevata*, Say, 1821; *M. multilincata*, Say, 1822; *M. catenaria*, Say, 1822; *M. proxima*, Say, 1825; *M. simplex*, Say, 1825; *M. laqueata*, Say, 1829; *M. depygis*, Say, 1829; *M. cancellata*, Say, 1829; *M. semicarinata*, Say, 1829; *M. acuta*, Lea, 1830; *M. subularis*, Lea, 1830; *M. livescens*, Menke, 1830; *M. fasciata*, Menke, 1830; *M. auriscalpium*, Menke, 1830; *M. curta*, Menke, 1830; *M. (Ambloxus) rugosa*,

Rafinesque, 1831; ? *M. (Ambloxyus) viridis*, Rafinesque, 1831; *Pleurocera acuta*, Rafinesque, 1831; *M. elongata*, Lea, 1831; *M. dislocata*, Ravenal, 1834; *M. carinata*, Ravenal, 1834; *M. bella*, Conrad, 1834; *M. comma*, Conrad, 1834; *M. vestita*, Conrad, 1834; *M. formosa*, Conrad, 1834; *M. semicostata*, Conrad, 1834; *M. nassula*, Conrad, 1834; *M. congesta*, Conrad, 1834; *M. exilis*, Haldeman, 1840; *M. catenaria*, Lea, 1840 (preocc.); *M. catenoides*, Lea, 1840; *M. Boykiniana*, Lea, 1840; *M. suturalis*, Haldeman, 1840; *M. interrupta*, Haldeman, 1840; *M. picta*, Lea, 1841; *M. Ocoënsis*, Lea, 1841; *M. levigata*, Lea, 1841; *M. nitens*, Lea, 1841; *M. dubiosa*, Lea, 1841; *M. gibbosa*, Lea, 1841; *M. Edgariana*, Lea, 1841; *M. nitida*, Lea, 1841; *M. nodulosa*, Lea, 1841; *M. Nickliniana*, Lea, 1841; *M. circumcincta*, Lea, 1841; *M. castanea*, Lea, 1841; *M. tenebrosa*, Lea, 1841; *M. sordida*, Lea, 1841; *M. costulata*, Lea, 1841; *M. dubia*, Lea, 1841; *M. striata*, Lea, 1841 (preocc.); *M. blanda*, Lea, 1841; *M. teres*, Lea, 1841; *M. Potosiensis*, Lea, 1841; *M. decora*, Lea, 1841; *M. rufa*, Lea, 1841; *M. crebricostata*, Lea, 1841; *M. Niagraensis*, Lea, 1841; *M. terebralis*, Lea, 1841; *M. Curryana*, Lea, 1841; *M. Troostiana*, Lea, 1841; *M. ebum*, Lea, 1841; *M. acuto-carinata*, Lea, 1841; *M. glabra*, Lea, 1841; *M. sulcosa*, Lea, 1841; *M. columella*, Lea, 1841; *M. caliginosa*, Lea, 1841; *M. concinna*, Lea, 1841; *M. subsolida*, Lea, 1841; *M. Warderiana*, Lea, 1841; *M. Lecontiana*, Lea, 1841; *M. claviformis*, Lea, 1841; *M. perfusca*, Lea, 1841; *M. obtusa*, Lea, 1841; *M. plicatula*, Lea, 1841 (preocc.); *M. Taitiana*, Lea, 1841; *M. corrugata*, Lea, 1841 (preocc.); *M. gracilis*, Lea, 1841; *M. Kirtlandiana*, Lea, 1841; *M. monozonalis*, Lea, 1841; *M. strigosa*, Lea, 1841; *M. subcylindracea*, Lea, 1841; *M. Babylonica*, Lea, 1841; *M. rufula*, Haldeman, Lea, 1841; *M. gracilis*, Anthony in Haldeman, 1841 (preocc.); *M. bella-crenata*, Haldeman, 1841; *M. costifera*, Haldeman, 1841; *M. approxima*, Haldeman, 1841; *M. symmetrica*, Haldeman, 1841; *M. intersita*, Haldeman, 1841; *M. unicalis*, Haldeman, 1841; *M. rugosa*, Lea, 1842; *M. expansa*, Lea, 1842; *M. striatula*, Lea, 1842; *M. laevis*, Lea, 1842 (preocc.); *M. Deshayesiana*, Lea, 1842; *M. levigata*, Lea, 1842 (preocc.); *M. rufescens*, 'Lea,' De Kay, 1843; *M. gemma*, De Kay, 1843; *M. bizonalis*, De Kay, 1843; *M. substricta*, Haldeman, 1844; *M. Curryana*, Lea, 1844; *M. lugubris*, Lea, 1844; *M. abrupta*, Lea, 1845; *M. ovoidea*, Lea, 1845; *M. carinocostata*, Lea, 1845; *M. Alexandriensis*, Lea, 1845; *M. spurca*, Lea, 1845; *M. Buddii*, Lea, 1845; *M. Haleiana*, Lea, 1845; *M. pallescens*, Lea, 1845; *M. modesta*, Lea, 1847; *M. spinalis*, Lea, 1847; *M. symmetrica*, Conrad, 1849 (preocc.); *M. nebulosa*, Conrad, 1849; *M. percarinata*, Conrad, 1849; *M. perangulata*, Conrad, 1849; *M. subilirata*, Conrad, 1850; *M. brevispira*, Anthony, 1850; *M. succinulata*, Anthony, 1850; *M. inornata*, Anthony, 1850; *M. abbreviata*, Anthony, 1850; *M. bicolorata*, Anthony, 1850; *M. densa*, Anthony, 1850; *M. elata*, Anthony, 1850; *M. tracta*, Anthony, 1850; *M. inempta*, Anthony, 1850; *M. pulchella*, Anthony, 1850;



*M. cuspidata*, Anthony, 1850 (preocc.); *M. plebeius*, Anthony, 1850; *M. coracina*, Anthony, 1850; *M. napella*, Anthony, 1850; *M. pagodiformis*, Anthony, 1850; *M. monilifera*, 'Anthony,' Jay, 1852; *M. Sellersiana*, Lea, 1852; *M. Ohioensis*, Lea, 1852; *M. Saffordi*, Lea, 1852; *M. furra*, Lea, 1852; *M. perstriata*, Lea, 1852; *M. Clarkii*, Lea, 1852; *M. sculptis*, Lea, 1852; *M. oblita*, Lea, 1852; *M. varicosa*, 'Ward MS.,' Haldeman, 1854; *M. viridula*, Anthony, 1854; *M. eliminata*, Anthony, 1854; *M. neglecta*, Anthony, 1854; *M. torulosa*, Anthony, 1854; *M. tecta*, Anthony, 1854; *M. tabulata*, Anthony, 1854; *M. hastata*, Anthony, 1854; *M. bacula*, Anthony, 1854; *M. curvilabris*, Anthony, 1854; *M. nigrocincta*, Anthony, 1854; *M. vittata*, Anthony, 1854; *M. subangulata*, Anthony, 1854; *M. pallidula*, Anthony, 1854; *M. imbricata*, Anthony, 1854; *M. altipeta*, Anthony, 1854; *M. bicincta*, Anthony, 1854; *M. iota*, Anthony, 1854; *M. arachnoidea*, Anthony, 1854; *M. coronilla*, Anthony, 1854; *M. brunnea*, Anthony, 1854; *M. virens*, Anthony, 1854; *M. gracilor*, Anthony, 1854; *M. casta*, Anthony, 1854; *M. rhombica*, Anthony, 1854; *M. angulata*, Anthony, 1854; *M. athleta*, Anthony, 1854; *M. latitans*, Anthony, 1854; *M. vicina*, Anthony, 1854; *M. elegantula*, Anthony, 1854; *M. Postelli*, Lea, 1858; *M. crenatella*, Lea, 1860; *M. funebris*, Anthony, 1860; *M. cubicoides*, Anthony, 1860; *M. angustispira*, Anthony, 1860; *M. adusta*, Anthony, 1860; *M. tenebrocincta*, Anthony, 1860; *M. bicostata*, Anthony, 1860; *M. occulta*, Anthony, 1860; *M. assimilis*, Anthony, 1860; *M. cognata*, Anthony, 1860; *M. valida*, Anthony, 1860; *M. bicincta*, Anthony, 1860; *M. corneola*, Anthony, 1860; *M. paucicostata*, Anthony, 1860; *M. hybrida*, Anthony, 1860; *M. glauca*, Anthony, 1860; *M. gracillima*, Anthony, 1860; *M. rigida*, Anthony, 1860; *M. pulcherrima*, Anthony, 1860; *M. intertexta*, Anthony, 1860; *M. versipellis*, Anthony, 1860; *M. tripartita*, Reeve, 1860; *M. intensa*, 'Anth. MS.,' Reeve, 1860; *M. surgillata*, Reeve, 1860; *M. Floridensis*, Reeve, 1860; *M. bicolor*, 'Anth. MS.,' Reeve, 1860; *M. incurta*, 'Anth. MS.,' Reeve, 1860; *M. cinnamomea*, 'Anth. MS.,' Reeve, 1860; *M. unguata*, 'Anth. MS.,' Reeve, 1860; *M. larvaformis*, 'Lea MS.,' Reeve, 1860; *M. abjecta*, 'Hald. MS.,' Reeve, 1860; *M. Deshayesiana*, Reeve, 1860 (preocc.); *M. scabrella*, 'Anth. MS.,' Reeve, 1860; *M. semigradata*, Reeve, 1861; *M. densicostata*, Reeve, 1861; *M. Etowahensis*, Lea in Reeve, 1861; *M. livida*, Reeve, 1861; *M. curvirostata*, 'Anth. MS.,' Reeve, 1861; *M. papillosa*, 'Anth. MS.,' Reeve, 1861; *M. tenera*, 'Anth. MS.,' Reeve, 1861, not of Hall, 1845; *M. paula*, Lea, 1861; *M. Cahawbensis*, Lea, 1861; *M. Leaii*, Brot, 1862; *M. scabriuscula*, Brot, 1862; *M. correcta*, Brot, 1862; *M. mutata*, Brot, 1862; *M. Conradi*, Brot, 1862; *M. charybæa*, 'Anth. MS.,' Brot, 1862; *Goniobasis auricomma*, Lea, 1862; *G. Lyonii*, Lea, 1862; *G. Binneyana*, Lea, 1862; *G. intercedens*, Lea, 1862; *G. cruda*, Lea, 1862; *G. strenua*, Lea, 1862; *G. Pybasii*, Lea, 1862; *G. rubella*,

Lea, 1862; *G. spinella*, Lea, 1862; *G. Christyi*, Lea, 1862; *G. olivella*, Lea, 1862; *G. Liedyana*, Lea, 1862; *G. Grosvenorii*, Lea, 1862; *G. rubricata*, Lea, 1862; *G. Whitei*, Lea, 1862 (preocc.); *G. Estabrookii*, Lea, 1862; *G. Downiana*, Lea, 1862; *G. parva*, Lea, 1862; *G. Gabbiana*, Lea, 1862; *G. rostellata*, Lea, 1862; *G. viridicata*, Lea, 1862; *G. subulaciformis*, Lea, 1862; *G. Bentoniensis*, Lea, 1862; *G. stricta*, Lea, 1862; *G. Spillmanii*, Lea, 1862; *G. Spartanburgensis*, Lea, 1862; *G. amœna*, Lea, 1862; *G. Lindsleyi*, Lea, 1862; *G. paupercula*, Lea, 1862; *G. proleteria*, Lea, 1862; *G. purpurella*, Lea, 1862; *G. continens*, Lea, 1862; *G. attenuata*, Lea, 1862; *G. Youmeyi*, Lea, 1862; *G. mediocris*, Lea, 1862; *G. interreniens*, Lea, 1862; *G. Duttonii*, Lea, 1862; *G. ornata*, Lea, 1862; *G. Anthonyi*, Lea, 1862; *G. Georgiana*, Lea, 1862; *G. Canbyi*, Lea, 1862; *G. instabilis*, Lea, 1862; *G. Carolinensis*, Lea, 1862; *G. induta*, Lea, 1862; *G. mutabilis*, Lea, 1862; *G. macella*, Lea, 1862; *G. Doolyensis*, Lea, 1862; *G. sparsa*, Lea, 1862; *G. Elliottii*, Lea, 1862; *G. cerca*, Lea, 1862; *G. Thorntonii*, Lea, 1862; *G. Viennaensis*, Lea, 1862; *G. Abbevillensis*, Lea, 1862; *G. inosculata*, Lea, 1862; *G. Brumbyi*, Lea, 1862; *G. difficilis*, Lea, 1862; *G. Couperii*, Lea, 1862; *G. cinerea*, Lea, 1862; *G. Hallenbeckii*, Lea, 1862; *G. inclinans*, Lea, 1862; *G. cadus*, Lea, 1862; *G. Vanuxemii*, Lea, 1862; *G. Uchee'nsis*, Lea, 1862; *G. crispa*, Lea, 1862; *G. Barrattii*, Lea, 1862; *G. cinerella*, Lea, 1862; *G. Fauziana*, Lea, 1862; *G. inconstans*, Lea, 1862; *Trypanostoma Vanuxemii*, Lea, 1862; *T. mucronatum*, Lea, 1862; *T. Knoxvilleense*, Lea, 1862; *T. Sycamore'ense*, Lea, 1862; *T. Chakusahense*, Lea, 1862; *T. Whitei*, Lea, 1862 (preocc.); *T. subulare*, Lea, 1862; *T. strictum*, Lea, 1862; *T. Henryanum*, Lea, 1862; *T. simplex*, Lea, 1862; *T. parvum*, Lea, 1862; *T. Knoxvilleense*, Lea, 1862; *T. attenuatum*, Lea, 1862; *T. pallidum*, Lea, 1862; *T. Estabrookii*, Lea, 1862; *T. Carolinense*, Lea, 1862; *T. mœstum*, Lea, 1862; *T. lativittatum*, Lea, 1862; *T. striatum*, Lea, 1862; *T. rostellatum*, Lea, 1862; *G. Decampii*, Lea, 1863; *G. Louisvillensis*, Lea, 1863; *G. infantula*, Lea, 1863; *G. lithasoides*, Lea, 1863; *G. aterina*, Lea, 1863; *G. Milesii*, Lea, 1863; *G. informis*, Lea, 1863; *G. Cumberlandicensis*, Lea, 1863; *G. porrecta*, Lea, 1863; *G. vittatella*, Lea, 1863; *T. Currierianum*, Lea, 1863; *T. Lyonii*, Lea, 1863; *T. luteum*, Lea, 1863; *G. Prestoniana*, Lea, 1864; *T. carinatum*, Lea, 1864; *T. corneum*, Lea, 1864; *G. Catabca*, Haldeman, 1865; *G. graminea*, Haldeman, 1865; *G. translucens*, Anthony, 1865; *G. interlineata*, Anthony, 1865; *G. Haldemani*, Tryon, 1865; *B. Conradi*, Tryon, 1865; *G. Canbyi*, Tryon, 1873; *G. Stearnsiana*, Call, 1886; *G. Crundalli*, Pilsbry, 1890; *G. Comalensis*, Pilsbry, 1896; ? *G. Columbiensis*, Whiteaves, 1905.

Shell of moderate size, acutely conic, whorls barely inflated, periphery normally sub-rounded, aperture elliptical, outer lip more or less sinuate and somewhat produced below; habitat lakes and streams.

Connecticut River, south to Florida, west to Michigan, Arkansas, and Texas, American Province.

Quaternary: Loess of eastern States.

Reported from Upper Columbia Lake, British Columbia, by Whiteaves. The record is a dubious one.

#### AMBLOXUS PLICIFERUS (Lea).

*Melania plicifera*, Lea, 1838; *M. occata*, Hinds, 1844; *M. bulbosa*, Gould, 1847 (normal); *M. silicula*, Gould, 1847; *M. Shastensis*, Lea, 1856; *M. nigrina*, Lea, 1856 (normal); *M. Wahlamatisensis*, 'Lea,' Carpenter, 1857 (nude name); *M. 'plicata*, Lea', Carpenter, 1857 (error for *plicifera*); *M. 'Shortensis*, Lea', W. Cooper, 1860 (error for *Shastensis*); *M. Newberryi*, Lea, 1860; *M. rudens*, Reeve, 1860; *Goniobasis Draytonii*, Lea, 1862; *G. Bairdiana*, Lea, 1862; *G. rubiginosa*, Lea, 1863; *G. plicifera*, var. *Oregonensis*, Tryon, 1865; *G. plicifera*, var. *bulinooides*, Tryon, 1865; *G. circumlineata*, Tryon, 1865; *M. Californica*, Clessin, 1882; *M. (Goniobasis?) acutiflora*, Stearns, 1891; *G. acutiflora Siskiyouensis*, Pilsbry, 1899; *G. Kettlemanensis*, Arnold, 1910.

Shell of moderate size, attenuate-conic, whorls rounded, sutures moderately impressed, periphery showing no trace of a carina, aperture elliptical, outer lip slightly sinuate, and somewhat produced below; habitat running streams and springs, infrequently in lakes.

Columbia, Klamath, Fraser (locally), Nevada (locally), and Coast Range (locally) Systems.

Pliocene: Kettleman Lake beds, California.

#### AMBLOXUS TENER (Hall).

*Cerithium tenerum*, Hall, 1845; *C. nodulosum*, Hall, 1845; *Goniobasis Carteri*, Conrad, 1869; *G. columinaris*, White, 1883, not *Melania tenera*, 'Anth. MS.,' Reeve, 1861 = *A. Virginicus*.

Shell similar to *A. Virginicus*, but the whorls usually more attenuate and less compressed, aperture but slightly sinuate; habitat apparently more or less lacustrine.

Eocene: Wasach, Green River, and Bridger formations of Rocky Mountains; Truckee Lake beds, Nevada.

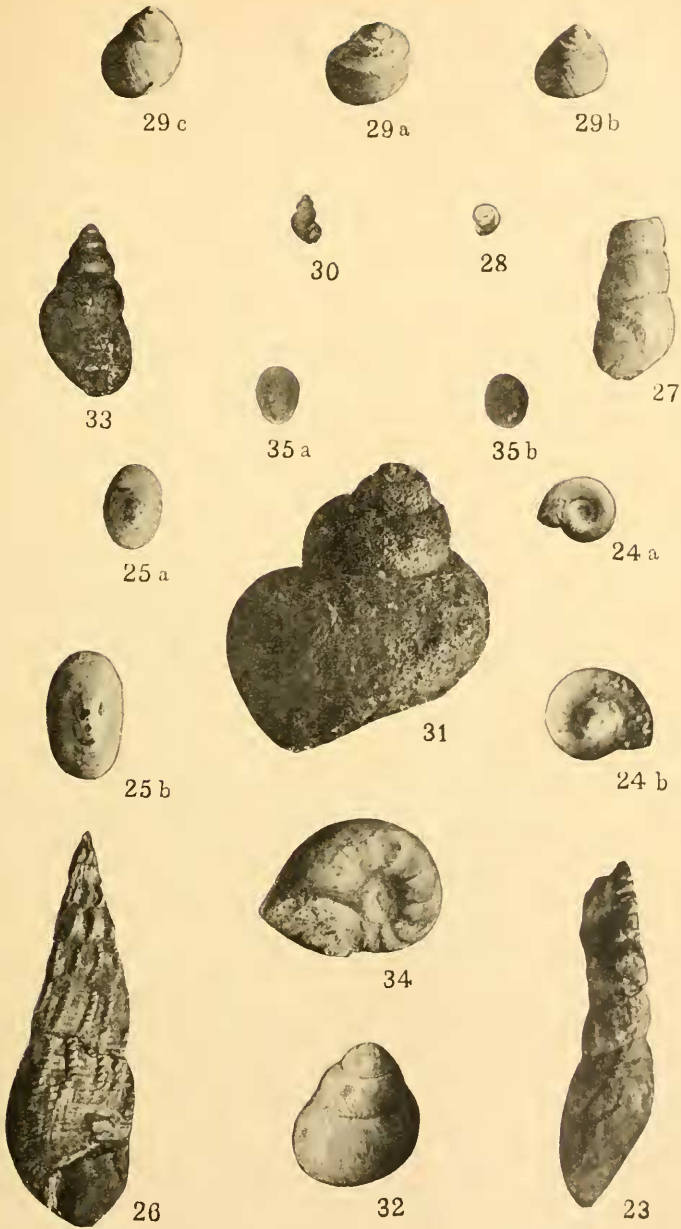
#### AMBLOXUS OLEQUAENSIS, Arnold & Hannibal, n.sp.

Pl. VIII, Fig. 27.

Shell slender-conic, similar in general outline and size to *A. Virginicus*, but more regularly elongate, with proportionally longer whorls, straight-sided above, and bending in rapidly at the suture somewhat after the manner of *Pleurocera biteniata*; sculptured forms with vertical plications and spiral ridges and frills as in *A. plicifera*; aperture deeply sinuate and slightly produced below; habitat apparently lacustrine, at least in part.

Altitude (estimated), 32 mm.; breadth, 9.5 mm.; altitude of body-whorl, 9 mm.

Eocene: Local freshwater beds in Tejon formation, Washington.



RECENT AND TERTIARY MOLLUSCA FROM WESTERN NORTH AMERICA.





Little Falls, Washington; bluffs along Olequa Creek above shoals 2 miles north of town (types); at shoals  $1\frac{1}{2}$  miles north of town; bend half a mile south of town (H. Hannibal).

Genus *GYROTOMA*, Shuttleworth.

*Schizostoma*, Lea, 1842 (*Melania* (*Schizostoma*) *excisa*, Lea), not *Schizostoma*, Bronn, 1835; *Gyrotoma*, Shuttleworth, 1845 (*G. ovoidea*, Shutt. = *M. excisa*, Lea); '*Melatoma*, Swainson,' Gray, 1847; *Schizochilus*, Lea, 1852 (*M. excisa*, Lea, by substitution), preocc. in Coleoptera; *Aphella*, 'Mighels' MS., Anthony, 1860 (no described species cited), in synonymy.

Sub-genus *GONIOBASIS* (Lea).

*Melania* (sp.), Conrad, 1834 (*M. olivula*, Conr.); *Megara* (sp.), H. & A. Adams, 1854 (*M. olivula*, Conr.); *Goniobasis* (*pars*), Lea, 1862 (*G. osculata*, Lea = *M. olivula*, Conr.); *Macrolimen*, Lea, 1862 (*Melania* (*Macrolimen*) *Showaltherii*, Lea = *M. olivula*, Conr.).

Type, *Melania olivula*, Conrad.<sup>1</sup>

Sub-genus *Goniobasis*. Shell rather small, averaging 20 mm. in altitude, solid, regularly conic, whorls appressed and normally smooth, with a rounded periphery, aperture ovate-elliptical, columella curved, outer lip barely sinuate, produced below, and slightly retracted above; habitat streams.

Sub-genus *Gyrotoma*, s.s. Shell as in *Goniobasis*, but the whorls sub-nodose below the suture, outer lip sinuate, terminating above in a sutural pleurotomariform cleft; *Goniobasis* stage passed during early adolescence; habitat streams.

*Gyrotoma* embraces two species and two sub-species characteristic of the Gulf States drainage. Two, both sub-species, belong to typical *Gyrotoma*, characterized by a remarkable pleurotomariform cleft analogous to the canal of *Io*, while the remaining forms group in *Goniobasis*, in which the more primitive normal character of the aperture is retained.

On the basis of the aperture alone *Goniobasis* is liable to be confused with *Ambloxus*, an error already fallen into by several writers,

<sup>1</sup> In describing *Goniobasis* Lea omitted to designate a type. The contents are referable to *Virginicus*, about sixty-five synonyms; *olivula*, eleven synonyms; *pliciferus*, two synonyms, etc. Some synonym of *Virginicus* would be the natural choice, but Lea expressly stated that *Virginicus* itself was to be retained in *Melania* for the time being, hence it cannot be regarded as a species available to become the type of the present group, and thus saves the name from falling into the synonymy of *Ambloxus*. Lea stated further that the genus might be divided into two sections, of which the first was to include the conical species (i.e. *olivula*), and the second the fusiform (i.e. *Virginicus* and *pliciferus*). The first species named is *G. osculata*, a synonym of *olivula*, which may be accepted since it constitutes the nearest approach to Lea's original intentions, regardless of what later writers have attempted to do with the name. The earlier *Megara* of the Adams was apparently intended for this same group, and, judging by the contents, would be a preferable name. However, it includes the monotype of the prior genus *Pleurocera*, and is unavailable.

while the build distinctly reminds one of *Pleurocera*, s.s. Conchologically the adults of these three form an almost complete transition from *Pleurocera* on the one hand to *Ambloxyus* on the other, yet there is no reason to regard them as anything but generically distinct. To the systematists, following out the idea embodied in Pelseneer's classification of the Pelecypoda, this may doubtless seem irrational; a simpler arrangement would be to group all the species in *Pleurocera* as the oldest generic name. Well and good, but *Pleurocera* represents a stock which has in it the latent possibilities of developing a fusiform canal, *Goniobasis* a plenrotomariform cleft, while the line of modification of *Ambloxyus* is not known, but would doubtless involve some similar modification of the aperture. In other words, these represent three closely allied stocks modifying in an analogous but not a homologous manner. The similarities are due to the fact that they have reached the same stage of specialization. It has been noted in *Helisoma* that a round-whorled stage is succeeded by a sculptured stage (carinate in that particular instance), and that in turn by a second round-whorled stage, while in the allied *Planorbis* a sculptured stage (carinate) is succeeded by a round-whorled, that in turn by a second sculptured stage (dentate), and that by another round-whorled stage. This alternation of sculptured and round-whorled stages is as characteristic of Gastropod evolution as the ever-increasing complexity of the lobing of the Ammonoids or the migration of the umbones to a terminal position in the Pelecypoda. These sculptured Gastropod stages invariably form a key to the relationships of species, but the round-whorled stages may not. In the Helicoid land shells, for instance, several families so closely resemble one another that it has only been with the study of the anatomy and embryonic whorls in recent years that even an approximation of relationships has been established. When the development of each species is studied carefully, numerous additional changes must be expected.

Of course, the anatomy should be examined to confirm the separations into *Pleurocera*, *Ambloxyus*, and *Goniobasis*. But the fact that the anatomy is unknown is no excuse for the sort of guesswork that has pervaded this group.

The genus is not certainly known in the fossil state.

#### GYROTOMA (GONIOBASIS) OLIVULA (Conrad).

*Melania olivula*. Conrad, 1834; *M. cylindracea*, Conrad, 1834; *M. equalis*, Haldeman, 1841; *M. impressa*, Lea, 1841; *M. fusiformis*, Lea, 1841; *M. crebristriata*, Lea, 1841; *M. Hayesiana*, Lea, 1842; *M. Vanuxemiana*, Lea, 1842; *M. protea*, Lea, 1845; *M. auriculæformis*, Lea, 1845; *M. harpa*, Lea, 1845; *M. basalis*, Lea, 1845; *M. arctata*, Lea, 1845; *M. calatura*, Conrad, 1849; *M. oppugnata*, Lea, 1852; *M. clara*, Anthony, 1854; *M. textilosa*, Anthony, 1854; *M. pupoidea*, Anthony, 1854; *M. cristata*, Anthony, 1854; *M. ampla*, Anthony, 1854; *M. ambusta*, Anthony, 1854; *M. absida*, Anthony, 1860; *M. decorata*, Anthony, 1860; *M. grata*, Anthony, 1860; *M. lachryma*, 'Anthony MS.,' Reeve, 1861; *M. varians*, Lea, 1861; *M. blanda*, Lea,

1861; *M. purpurea*, Lea, 1861; *M. punicea*, Lea, 1861; *M. quadricittata*, Lea, 1861; *M. clausa*, Lea, 1861; *M. fascians*, Lea, 1861; *M. propria*, Lea, 1861 (preocc.); *M. rara*, Lea, 1861; *M. fallax*, Lea, 1861; *M. Coosaensis*, Lea, 1861; *M. rubicunda*, Lea, 1861; *M. propinqua*, Lea, 1861; *M. solidula*, Lea, 1861; *M. gratiosa*, Lea, 1861; *M. capillaris*, Lea, 1861; *M. elliptica*, Lea, 1861; *M. midas*, Lea, 1861; *M. fumea*, Lea, 1861; *M. lita*, Lea, 1861; *M. gracilor*, Lea, 1861 (preocc.); *M. Shelbyensis*, Lea, 1861; *M. pergrata*, Lea, 1861; *M. Alabamensis*, Lea, 1861; *M. nubia*, Lea, 1861; *M. crepera*, Lea, 1861; *M. Showalterii*, Lea, 1861; *M. aqua*, Lea, 1861; *M. Hartmaniana*, Lea, 1861; *M. luteola*, Lea, 1861; *M. straminea*, Lea, 1861; *Goniobasis flavescens*, Lea, 1862; *G. granata*, Lea, 1862; *G. Stewardsoniana*, Lea, 1862; *G. Tryoniana*, Lea, 1862; *G. negata*, Lea, 1862; *G. fabalis*, Lea, 1862; *G. Pratriensis*, Lea, 1862; *G. flava*, Lea, 1862; *G. tenebrosittata*, Lea, 1862; *G. Bridgesiana*, Lea, 1862; *G. Gerhardtii*, Lea, 1862; *G. infusca*, Lea, 1862; *G. osculata*, Lea, 1862; *G. gibberosa*, Lea, 1862; *G. Hartmanii*, Lea, 1862; *G. pudica*, Lea, 1863; *G. ellipsoides*, Lea, 1863; *G. lepida*, Lea, 1863; *G. quadricincta*, Lea, 1864; *Eurycalon Leati*, Tryon, Lea, 1866; *G. Leai*, Tryon, 1873; *G. 'inosculata*, Lea', Tryon, 1873.

Shell of moderate size, conical, whorls sub-inflated, aperture narrowly elliptical; habitat streams.

Coosa and adjacent streams flowing into the Gulf of Mexico; American Province.

#### GYROTOMA (GONIOBASIS) LETA (Jay).

*Melania lata*, Jay, 1839; *M. inflata*, Haldeman, 1841; *M. robusta*, Lea, 1841; *M. ovalis*, Lea, 1842; *M. gravida*, Anthony, 1860; *M. Germana*, Anthony, 1860; *M. grisea*, Anthony, 1860; *M. tenuolata*, Anthony, 1860; *M. 'Buddii*, Lea', Reeve, 1860; *M. obesa*, 'Anthony MS.', Reeve, 1861; *M. orbicula*, Lea, 1861; *M. copiosa*, Lea, 1861; *M. virgulata*, Lea, 1861; *M. culta*, Lea, 1861; *M. glandaria*, Lea, 1861; *M. variata*, Lea, 1861; *M. sawvis*, Lea, 1861; *M. bellula*, Lea, 1861; *M. culenoides*, Lea, 1861; *M. Lewisii*, Lea, 1861.

Shell of moderate size, broadly conical, whorls not inflated, aperture broadly elliptical; habitat streams.

Coosa and adjacent streams flowing into the Gulf of Mexico, east to Florida; American Province.

#### GYROTOMA OLIVULA EXCISA (Lea).

*Melania (Schizostoma) excisa*, Lea, 1842; *Schizostoma curtum*, Mighels, 1844; *S. cylindraceum*, Mighels, 1844; *S. laciniatum*, Lea, 1845; *Gyrotoma ovoidea*, Shuttleworth, 1845; *G. carinifera*, Anthony, 1860; *G. ampla*, Anthony, 1860; *G. bulbosa*, Anthony, 1860; *G. ovalis*, Anthony, 1860; *Melatoma spherica*, 'Anth. MS.', Reeve, 1860; *M. nucula*, 'Anth. MS.', Reeve, 1860; *M. elliptica*, 'Anth. MS.', Reeve, 1860; *M. 'Alabamensis*, Lea',

Reeve, 1860; *S. Showaltherii*, Lea, 1860; *S. castaneum*, Lea, 1860; *S. pumilum*, Lea, 1860; *S. globosum*, Lea, 1860; *S. glans*, Lea, 1860.

Shell as in *olivula*. but the outer lip sinuate and terminating above in a rather broad deep sutural pleurotomariform cleft, body-whorl sub-suturally nodose; *olivula* stage passed during adolescence; habitat streams.

Coosa River, Alabama; American Province.

GYROTOMA LÆTA INCISA (Lea).

*Melania* (*Schizostoma*) *incisa*, Lea, 1842; *Schizostoma pagoda*, Lea, 1845; *S. Babylonicum*, Lea, 1845; *S. funiculatum*, Lea, 1845; *S. Buddii*, Lea, 1845; *S. constrictum*, Lea, 1845; *Gyrotoma pyramidata*, Shuttleworth, 1845; *S. Wetumpkaense*, Lea, 1860; *S. Alabamense*, Lea, 1860; *S. Hartmanii*, Lea, 1860; *S. glandula*, Lea, 1860; *S. virens*, Lea, 1860; *G. quadrata*, Anthony, 1860; *G. robusta*, Anthony, 1860; *G. salebrosa*, Anthony, 1860; *G. recta*, Anthony, 1860; *G. demissa*, Anthony, 1860; *Melatoma ornata*, 'Anth. MS.' Reeve, 1860; *M. Anthonyi*, Reeve, 1860; *S. Spillmanii*, Lea, 1861; *S. Showaltherii*, Lea, 1864 (preocc.); *S. Showaltherianum*, Tryon, 1873.

Shell similar to *læta*, but the outer lip somewhat sinuate and terminating above in a very deep narrow pleurotomariform cleft, whorls sub-nodose below the suture; *læta* stage passed during adolescence; habitat streams.

Coosa River, Alabama; American Province.

Like the preceding a well-marked northern or western race.

Unrecognized: *Melania* (*Goniobasis*) *Furuhjelmi*, Mayer, 1869.

Miocene (?) of Alaska.

Family MELANOPSIDÆ, H. & A. Adams, 1854.

Genus PACHYCHILUS, Lea.

*Pachychilus*, Lea, 1850 (*P. Cumingii*, Lea); *Pachycheilus*, H. & A. Adams, 1854 (emended form).

Type, *Pachychilus Cumingii*, Lea.

Three Melanoids from the sub-tropical Eocene and Miocene deposits, evidently allied to one another, but not grouping closely with any of the known genera of Pleuroceridæ, may be tentatively placed in this Mexican group. Their true generic position remains to be established.

PACHYCHILUS TAYLORI (Gabb).

*Melania Taylori*, Gabb, 1866; *Melania* (*Goniobasis*?) *sculptis*, Meek, 1870, not of Lea, 1852; *M. (G.?) subsculptis*, Meek, 1870.

Shell of moderate size, slender-conical, whorls appressed and rather long, sutures somewhat impressed, periphery rounded, aperture elliptical, outer lip slightly sinuate; habitat apparently lacustrine, at least in part.

Eocene: Payette Lake beds, Idaho and Oregon; Truckee Lake beds, Nevada.

## PACHYCHILUS LAWSONI, n.sp. Pl. VIII, Fig. 23.

Shell slender-conic, spire attenuate and regularly tapering, whorls very long and appressed, without a distinct periphery, normally smooth, but sculptured forms with several ridges of even magnitude crossed by plications, aperture but slightly sinuate and produced below; habitat apparently lacustrine, at least in part.

Length 27, breadth 10, altitude of body-whorl 12 mm.

Miocene: Contra Costa Lake beds, California.

Berkeley Hills, California; near Bald Peak (types) (H. Hannibal); same locality (D. A. C. Lawson, Dr. J. C. Merriam, *et al.*); Grizzly Peak (Dr. A. C. Lawson, Dr. J. C. Merriam, *et al.*); north flank of Ruin Peak (Dr. J. C. Merriam, *et al.*).

Named after Dr. A. C. Lawson, of the University of California.

## PACHYCHILUS DRAKEI, Arnold &amp; Hannibal, n.sp. Pl. VIII, Fig. 26.

Shell large, averaging about 45 mm. in altitude, elevated-conical, whorls long and slightly convex, sutures impressed, periphery rounded, aperture elliptical, outer lip sinuate; habitat apparently lacustrine, at least in part.

Altitude 45, breadth 14, altitude of body-whorl 12 mm.

Eocene: Tejon formation (local freshwater beds), Washington.

Little Falls, Washington; Bluffs along Olequa Creek at bend below town (H. Hannibal).

Only a single specimen, evidently syntonically deformed, is at hand. The sculpturing consists of about twelve rugose plications crossed by an equal number of spirals.

Named after Dr. N. F. Drake, of the Department of Geology, Stanford University.

## Superfamily RISSOIDEÆ (H. &amp; A. Adams), 1854.

Aside from the marine Rissoidæ, Rissoidinidæ, Skeneidæ, and Hydrobiidæ, and the terrestrial Pomatiopsidæ, the Rissoids include two aquatic families—the Amnicolidæ, Tryon, 1862 (+Fluminicolinæ, Clessin, 1880, Lithoglyphinæ, Tryon, 1883, and Paludestrinidæ, Newton, 1891), and Bulimidæ, nom. nov.<sup>1</sup> (Bythininæ, Tryon, 1863).

<sup>1</sup> Type genus *Bulinus*, Scopoli (*Bithynia*, Leach, *Bythinia* and *Bithinia* of authors). The name has not come into general use, but as may be seen from the following is necessarily applicable.

1757. Adanson, *Histoire Naturelle du Sénégal, Coquillages*, p. 5, pl. i, described and figured "Le Bulin, *Bulinus*", from the fresh waters of Africa. This is one of the physiform Planorbidæ.

1777. Scopoli, *Introductio ad Historiam Naturalium*, p. 392, proposed '*Bulinus*, Adanson' for the four aquatic and amphibious species of the Linnæan *Helix*, viz. *H. putris* (*Succinea putris*), *H. fragilis* (*Lymnæa stagnalis*), *H. stagnalis* (*Lymnæa stagnalis*), and *H. tentacula* (*Bythinia tentacula*). The diagnosis is not that of Adanson's *Bulinus*, which is not mentioned. No reference is given to where Adanson may have used *Bulinus*.

1781. Müller in *Der Naturforscher*, pp. 1-20, described the anatomy of "der Perlen-Blasen" (*Physa fontinalis*), and revived Adanson's *Bulinus*, ostensibly for the physiform section of his genus *Planorbis* of the preceding



Various authors have disagreed in regard to the limits of the Amnicolidæ; on the one hand it has been extended to include all the not strictly marine Rissoïd genera, while on the other it has been subdivided on the most superficial characters. Doubtless when restricted to embrace only the freshwater Rissoïdæ with horny sub-spiral opercula, it is a rather over-comprehensive group, but the anatomical studies necessary to segregate the genera into families and sub-families would require fine all out of proportion to the results to be gained in the present discussion.

#### Family AMNICOLIDÆ, Tryon, 1862.

Shell small or minute, sub-solid, varying from globose to attenuate, imperforate or umbilicate, whorls more or less inflated, sutures impressed, aperture ovate and somewhat retracted below; animal oviparous, rostrum short and broad, tentacles cylindrical, blunt or tapering, foot short and broad, auriculated in front, rounded behind, and more or less constricted in the middle, operculum corneous and paucispiral, with a sub-central nucleus; habitat lacustrine and fluviatile.

Six more or less localized genera, *Ammicola*, *Paludestrina*, *Flumini-cola*, *Pyrgulopsis*, *Cincinnatia*, and *Brannerillus*, occur in the present

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year. Adanson's species is included and given a binomial name. His group contains: (1) *Bulinus perla* (*Planorbis bulla*, Müll., *Bulla fontinalis*, L.) = *Physa fontinalis*; (2) *B. turritus* (*Planorbis turritus*, Müll., *Bulla hypnorum*, L.) = *Physa hypnorum*; (3) *B. gelatinus* (*Planorbis gelatinus*, Müll.) = ? *Physa fontinalis*; (4) *B. Senegalensis* (Le Bulin, *Bulinus*, Adanson).

1786. Scopoli, *Deliciae Floræ et Faunæ Insubricæ*, i, p. 67, used *Bulinus* for a South American land shell belonging to *Borus*, Albers, 1850.

From these data we may draw the following conclusions.

*Bulinus*, Adanson, is not binomial and pre-Linnæan, hence can only be cited historically.

*Bulinus*, Scopoli, 1777, may be based on *Bulinus*, Adanson, 1757, or it may be based on some manuscript *Bulinus* of Adanson. No clue is given to where Adanson may have used the name, therefore there is no way of determining. If *Bulinus*, Adanson, was a manuscript name, it would have to be cited as of Scopoli, however, as its first use in print. If *Bulinus* is derived from *Bulinus*, Scopoli's attribution of the genus to Adanson explains the derivation of the word, but the fact that he altered the spelling and used the name for a group, in which Adanson's species was not included, places it on a distinct nomenclatural basis, hence it must be cited as of Scopoli in any event. *Helix tentacula*, L., has been named by Dall as a type by elimination, thus giving it priority over *Bithynia*, Leach, 1818.

*Bulinus*, Müller, is *Bulinus*, Adanson, adopted into binomial nomenclature. Adanson's species must go with it, in any event, since it is the type by autonomy and subsequent elimination.

*Bulinus*, Scopoli, 1786, makes it impossible to question *Bulinus*, 1777, as a lapsus for *Bulinus*. Its use for a land shell does not concern the applicability of the name for the species previously included. Scopoli may have thought his species was aquatic.

The similarity in orthography is undesirable, but does not affect the use of the names.

One species, *Bulinus tentaculus*, L., occurs as an introduced form in the drainage of the Great Lakes and adjacent waters of North America.

district. The shell characters offer only partial satisfaction in their discrimination.

Genus AMNICOLA, Gould & Haldeman.

*Paludina* (sp.), Say, 1819 (*P. limosa*, Say); *Ammicola*, Gould and Haldeman, in Haldeman, 1840, no species cited; in Gould, 1841 (*P. porata*, Say (= *P. limosa*, Say), first species, cited by H. & A. Adams, 1854).

Type, *Paludina limosa*, Say.

Shell of moderate size, averaging 4 mm. in altitude, conic-globose, sub-perforate, epidermis pale horn-coloured, whorls inflated, sutures impressed, spire regularly elevated, apex small and obtuse, aperture ovate, peritreme continuous; habitat quiet streams, lakes, and springs.

AMNICOLA LIMOSA (Say).

*Paludina limosa*, Say, 1817; *P. porata*, Say, 1821; *A. parva*, Lea, 1841.

Shell large for genus, globose-conic, sutures impressed, spire elevated; habitat quiet streams and lakes.

Boreal portions of American Province. Utah System.

Quaternary: Loess of eastern States; Bonneville Lake beds, Utah.

AMNICOLA MICROCOCCUS, Pilsbry.

*Ammicola micrococcus*, Pilsbry, in Stearns, 1902.

Shell minute, globose-conic, spire somewhat elevated, sutures barely impressed; habitat springs.

Mojave System.

Unrecognized: *Ammicola abavia*, Mayer, 1869. Miocene (?) of Alaska.

GENUS PALUDESTRINA, d'Orbigny.

*Bulimus* (sp.), Poiret, 1801 (*B. viridis*, Poir.); *Turbo* (sp.), Vall, 1801 (*T. griseus*, Vall = *P. viridis*, Poir.); *Cyclostoma* (sp.), Draparnaud, 1801 (*C. vitreum*, Drap.); *Hydrobia* (sp.), Hartmann, 1821 (*C. vitreum*, Drap.); *Paludina* (sp.), Hartmann, 1821 (*B. viridis*, Poir.); *Leachia*, Risso, 1826 (*C. vitrea*, Drap.), not *Leachia*, Lesueur, 1821; *Paludestrina*, d'Orbigny, 1840 (*Paludina acuta*, Desh.); *Ammicola* (sp.), Haldeman, 1844 (*A. attenuata*, Hald. = *Paludina Nickliniana*, Lea); *Bithinia* (sp.), Dupuy, 1849 (*B. viridis*, Poir.); *Bythinella*, Moquin-Tandon, 1851 (*B. viridis*, Poir.); *Melania* (sp.), Conrad, 1855 (*M. exigua*, Conr. = *A. protea*, Gld.); *Heleobia*, Stimpson, 1865 (*Paludestrina culminea*, d'Orb.), preocc.; *Tryonia*, Stimpson, 1865 (*T. clathrata*, Stimp. = *A. protea*, Gld.); *Stimpsonia*, Clessin, 1878 (*Paludina Nickliniana*, Lea).

Type, *Paludina acuta*, Deshayes.

Shell small or minute, averaging 4 mm. in altitude, elongate-conic or attenuate, sub-perforate, whorls inflated, epidermis pale horn-coloured, spire regularly elevated, apex small and obtuse, aperture ovate, peritreme incomplete; habitat lakes, streams, and springs.

The writer entertains doubts that the American species are true

Paludestrinas. If not, *Tryonia* would become available for their reception. Of all the aquatic operculates this group is doubtless one of the most in need of severe critical revision.

PALUDESTRINA PROTEA (Gould).

*Annicola protea*, Gould, 1855 (syntonic form); *Melania exigua* Conrad, 1855 (syntonic form); *Hydrobia Seemani*, Frauenfeld, 1863; *Tryonia clathrata*, Stimpson, 1865 (syntonic form); *Bythinella Hemphilli*, Pilsbry, 1890; *P. Stokesi*, Arnold, 1903.

Shell usually of rather large size but variable in this respect, attenuate-conic, sub-perforate, sutures moderately impressed; habitat lakes and springs.

Mexican Province. Utah, Nevada, Columbia, Mojave, and Arizona Systems. Probably present in Klamath, Coast Range, Los Angeles, and Colorado Systems.

Quaternary: Le Conte Lake beds and San Pedro formation (specimens washed into marine terraces), California; Summer Lake beds, Oregon.

Pliocene: Kettleman Lake beds, California.

PALUDESTRINA LONGINQUA (Gould).

*Annicola longinqua*, Gould, 1855; *Pomatiopsis intermedia*, Tryon, 1865; *Bythinella 'Binneyi*, Tryon', J. G. Cooper, 1888, in part; *P. Stearnsiana*, Pilsbry, 1899; *P. imitator*, Pilsbry, 1899; *P. curta*, Arnold, 1903; *P. Andersoni*, Arnold, 1910.

Shell small or of moderate size, elevated-conic, sub-perforate, sutures well impressed; habitat lakes, mountain streams, and springs, generally in organic mud with *Corneocyclas*.

Utah, Nevada, Columbia (locally), Coast Range, Mojave, Los Angeles, Arizona, and Colorado Systems.

Quaternary: Le Conte Lake beds, calcareous spring deposits of Santa Cruz Mountains, and San Pedro formation (specimens washed into marine terraces), California; Lahontan Lake beds, Nevada; Bonneville Lake beds, Utah. Pliocene: Santa Clara, Cache, and Kettleman Lake beds, California.

Genus FLUMINICOLA, Stimpson.

*Paludina* (sp.), Lea, 1838 (*P. virens*, Lea); *Annicola* (sp.), Baird, 1863 (*A. Hindsii*, Baird = *P. virens*, Lea); *Fluminicola*, Stimpson, 1865 (*P. Nuttalliana*, Lea = *P. virens*, Lea).

Type, *Paludina virens*, Lea.

Sub-genus HEATHILLA, n. sub-gen.

*Anculosa* (sp.), Haldeman, 1841 (*A. fusca*, Hald.).

Type, *Paludina seminalis*, Hinds.

Named in honour of Dr. Harold Heath, under whose guidance a portion of the anatomical studies involved in these pages were made.

Sub-genus *Fluminicola*, s.s. Shell of moderate size, averaging 5 mm. in altitude, elevated-conic, spire decidedly elevated, early volutions slender but expanding rapidly before maturity is reached, whorls inflated, sloping downward and outward, sutures impressed; habitat streams and springs.

Sub-genus *Heathilla*. Shell similar to preceding but more nearly globose, sub-perforate, the spire but little elevated, early adolescent whorls slender, but the later ones expanding more rapidly than in *Fluminicola*, s.s., sutures shallow, *Fluminicola* stage carried back to mid-adolescence; habitat similar.

The bulk of the *Fluminicolas* belong to *Heathilla*, which may be readily distinguished by its globose form. Judging by the localized distribution of the representatives of this genus, additional species may be expected when the Great Basin and adjacent desert regions are explored more fully.

FLUMINICOLA VIRENS (Lea).

*Paludina virens*, Lea, 1838; *P. nuclea*, Lea, 1838; *P. Nuttalliana*, Lea, 1838; *Amnicola Hindsii*, Baird, 1863.

Shell large, elevated-conic, imperforate, epidermis dark green or tawny, spire elevated, sutures well impressed; habitat streams and springs.

Columbia and Fraser (locally) Systems.

FLUMINICOLA MODOCI, n.sp. Pl. VIII, Fig. 30.

Shell small, elevated-conic, imperforate, epidermis green-brown, spire decidedly elevated, sutures deeply impressed; habitat springs.

Altitude (estimated) 5·0, breadth 3·2, altitude of aperture 2·6 mm.

Nevada System (locally).

California: Fletcher's spring, south end of Goose Lake (type); Fritter's spring, head of Willow Creek, Honey Lake basin; Troxel's spring, Eagle Lake (H. Hannibal).

In the new edition of *West Coast Shells* this distinct little *Fluminicola* was figured as *Amnicola micrococcus*, to which it bears some resemblance, though that Rissoid is even more minute and sub-perforate. *F. Modoci* appears to be confined to the lava beds of North-Eastern California and the adjacent portions of Oregon and Nevada, once the home of the Modoc Indians, who, led by the intrepid Captain Jack, for a number of years successfully resisted the settlement of the country by the whites.

FLUMINICOLA (HEATHILLA) FUSCA (Haldeman).

*Anculosa fusca*, Haldeman, 1841; *Amnicola 'turbiniformis'*, Tryon', J. G. Cooper, 1871, *pars*.

Shell large, nearly globose, sub-perforate, epidermis dark silvery-brown, spire somewhat elevated, sutures impressed, whorls deep; habitat streams.

Utah System.

Quaternary: Bonneville Lake beds, Utah.

FLUMINICOLA (HEATHILLA) SEMINALIS (Hinds).

*Paludina seminalis*, Hinds, 1842; *P. 'nuclea'*, Lea', Hinds, 1844; *F. 'Nuttalliana'*, Lea', Binney, 1865, *pars*; *Amnicola turbiniformis*, Tryon, 1865; *F. 'fusca'*, Haldeman', Call, 1884, *pars*; *A. Dalli*, Call, 1884.

Shell large, globose, sub-perforate, epidermis green-brown, spire but little elevated, sutures not appreciably impressed, whorls deep; habitat streams and springs.

Klamath and Nevada Systems.

Varies much in size; specimens from springs are prevailingly dwarfed.

FLUMINICOLA (HEATHILLA) MERRIAMI, Pilsbry & Beecher.

*F. Merriami*, Pilsbry & Beecher, 1892.

Shell small, globose-turbinate, perforate, epidermis horn-coloured, sutures somewhat impressed, whorls rather deep; habitat springs.

Mojave System.

FLUMINICOLA (HEATHILLA) ERYTHROPOMA, Pilsbry.

*F. fusca*, var. *minor*, Stearns, 1893 (nude name, not used in a strictly varietal sense); *F. erythropoma*, Pilsbry, 1899.

Shell small, globose-turbinate, sub-perforate, epidermis silvery corneous, sutures somewhat impressed, whorls fairly deep, operculum with slowly increasing volutions and sub-central nucleus; habitat springs.

Mojave System.

FLUMINICOLA (HEATHILLA) COLUMBIANA, Pilsbry.

*F. Columbiana*, 'Hemphill MS.,' Pilsbry, 1899.

Shell of moderate size, sub-globose, barely perforate, epidermis dark purplish-black, spire moderately elevated, sutures well impressed, whorls not deep; habitat streams.

Columbia System (locally).

FLUMINICOLA (HEATHILLA) MINUTISSIMA, Pilsbry.

*F. minutissima*, Pilsbry, 1907.

Shell minute, broadly obliquely globose, perforate, epidermis olive-yellow, sutures impressed, whorls strongly inflated but not deep; habitat streams.

Columbia System (locally).

GENUS PYRGULOPSIS, Call & Pilsbry.

*Pyrgula* (sp.), Wolf, 1869 (*P. scalariformis*, Wolf); *Pyrgulopsis* Call & Pilsbry, 1886 (*Pyrgula Nevadensis*, Stearns).

Type, *Pyrgula Nevadensis*, Stearns.

Shell varying from small to large size, averaging 5 mm. in altitude, turreted-conic, imperforate or sub-umbilicate, epidermis pale horn-coloured, whorls somewhat inflated, rounded in adolescent stage, rounded, coronate, or peripherally carinate in adult, the carina frequently becoming obsolete in senile condition, sutures more or less impressed in rounded stages, apex usually small and obtuse, aperture ovate, peritreme continuous; habitat chiefly confined to lakes.

*Pyrgulopsis* is an interesting group on account of the pronounced shortening up of the sculptured stage; specimens in each species frequently pass directly from the juvenile to the senile round-whorled stage with but a barely appreciable development of the carina, and in no instance does it occupy a considerable period.



*P. Nevadensis* is the only living representative of the genus west of the Rocky Mountains. To this must be added, however, several additional forms particularly from the Pliocene lake deposits of California. Other undescribed Amnicolids from the extensive lacustrine beds of this period on the coast are probably congeneric, but the writer prefers to delay their description until the sculptured forms are discovered and their generic position positively established. The *Pyrgulopses* are characteristically localized in distribution, and the fossil forms were apparently rather short-lived, hence become valuable in horizon determination.

PYRGULOPSIS ANTIQUA (Gabb).

*Lithasia antiqua*, Gabb, 1866.

Shell large, sub-globose, spire elevated, whorls rounded and smooth, sutures somewhat impressed, aperture ovate, outer lip slightly sinuate, peritreme incomplete; habitat apparently lacustrine.

Eocene: Payette Lake beds, Idaho and Oregon.

The writer has seen specimens of this species, but has not had the opportunity to study the early whorls. While the large size and globose form suggest *Anculosa* somewhat, there is scarcely any likelihood that it belongs to that family. Its affinities are rather with the present group, though it is by no means certain that it is really congeneric with *P. Nevadensis*. The proper disposition of fossil Amnicolidæ into their respective genera is frequently rather embarrassing owing to the absence of well-marked shell characters.

PYRGULOPSIS NEVADENSIS (Stearns).

*Pyrgula Nevadensis*, Stearns, 1883.

Shell of moderate size, slender-conic, imperforate, spire decidedly elevated, sutures well impressed; habitat lakes.

Nevada System (locally).

Quaternary: Lahontan Lake beds, Nevada.

The prevailing form is peripherally carinate.

PYRGULOPSIS YATESIANA (J. G. Cooper).

*Amnicola Yatesiana*, J. G. Cooper, 1894.

Shell rather large, pupiform-globose, umbilicate, spire somewhat elevated, sutures not deeply impressed; habitat, apparently a lake species.

Pliocene: Santa Clara Lake beds, California.

The prevailing form is the rounded one, but peripherally carinate individuals are not rare at certain localities.

PYRGULOPSIS WILLIAMSII, n.sp. Pl. VIII, Fig. 29.

*Amnicola 'turbiformis'*, Tryon, J. G. Cooper, 1894.

Shell of very large size, broadly conic-globose, sub-perforate, spire somewhat elevated, sutures more or less impressed; habitat, apparently a lake species.

Type (a coronate individual): altitude 8·5, breadth 7, altitude of body-whorl 6 mm. Co-type (a peripherally carinate individual): altitude 7, breadth 6·3 mm. Co-type (a rounded individual): altitude 8·7, breadth 7 mm.

Pliocene: Kettleman Lake beds, California.

Hills bordering Tulare Valley on west, California; Martin and Dudley's oil-well, south-east quarter of section 32, township 26 south, range 21 east, Lost Hills (types) (W. Williams); east of Dudley-Lemoor road, south-west quarter of section 17, township 23 south, range 19 east, east border of Kettleman Hills (Ferguson); opposite Tulare Lake, west border of Kettleman Hills (W. L. Watts), *vide* Watts; well at depth of 1,058 feet, Lambertson's ranch near Tulare Lake (W. L. Watts), *vide* Watts.

*P. Williamsi* is the largest and most compact *Pyrgulopsis* yet described, though *Yatesiana* approaches it somewhat. The prevalent type in the Kettlemans appears to be the rounded form, and upon this it seems almost certain that Cooper founded his record of *Amnicola turbiniformis* (*Fluminicola seminalis*). This is the only species in these deposits which resembles a *Fluminicola* particularly, but, owing to the destruction in the San Francisco fire of the material on which Cooper based his report, which was among the California Academy collections, there has been no opportunity of verifying such a supposition. In the Lost Hills no exposures of these lake beds are known, but through the courtesy of Mr. W. Williams, chief geologist of the Associated Oil Company, the writer is indebted for some interesting material derived from an oil-well at a considerable depth. In this set, rounded, peripherally carinate, and coronate individuals are present, the latter prevailing. From one of these the type has been selected.

#### GENUS CINCINNATIA, Pilsbry.

*Paludina* (sp.), Anthony, 1840 (*P. Cincinnatiensis*, Anth.); *Amnicola* (sp.), Anthony, 1843 (*P. Cincinnatiensis*, Anth.); *Cincinnatia*, Pilsbry, 1891 (*P. Cincinnatiensis*, Anth.).

Type, *Paludina Cincinnatiensis*, Anthony.

Shell of moderate size, averaging 5 mm. in altitude, elevated conic-globose, epidermis horn-coloured, whorls strongly inflated and umbilicate, sutures deep, spire elevated and sub-pupiform, apex bluntly obtuse, aperture sub-circular, peritreme complete; habitat lakes and sluggish streams.

The genus contains, so far as known, two species, *C. Cincinnatiensis*, which should not be confused with '*Cyclostoma*' *Cincinnatiensis*, Lea, a *Pomatiopsis*, and *C. Binneyana*, nom. nov.<sup>1</sup>

<sup>1</sup> *Paludina obtusa*, Lea, 1841, not of Troschel, 1837. This has passed in the literature as *Paludina emarginata*, Küster. Whether or not Küster had this shell before him is of no consequence; he identifies his species with *Lymnaeus emarginatus*, Say; hence the name is entirely inadmissible in this connexion. Lea's name is a homonym, therefore *C. Binneyana* may be substituted.

The two are almost wholly peculiar to the American Province, *C. Cincinnatiensis* alone extending west as far as the Great Basin.

CINCINNATIA CINCINNATIENSIS (Anthony).

*Paludina Cincinnatiensis*, Anthony, 1840.

Shell large and ventricose, spire elevated-conic; habitat lakes and sluggish streams.

American Province. Utah System.

Quaternary: Loess of eastern States; Bonneville Lake beds, Utah.

Genus BRANNERILLUS, n.gen.

Type, *Brannerillus physispira*, n.sp.

Shell of rather small size, averaging 2.5 mm. in altitude, conic-globose, whorls rounded or peripherally carinate, giving the shell the appearance of an *Astræa*, umbilicate, sutures impressed, spire elevated, but the apex conspicuously depressed below the plane of the succeeding whorl, aperture nearly circular in rounded forms, peritreme complete; habitat apparently lacustrine.

The present group is known to the writer only from a single fossil species, but the peculiar planorbiform apex immediately distinguishes it from the other Nearctic genera of Amnicolidæ, *Cincinnatia* approaching it most closely. In the development of a peripheral keel in some instances, it resembles *Pyrgulopsis*, but the outline is proportionately much narrower, and the apex merely obtuse in that genus.

Named after Dr. J. C. Branner, of the Department of Geology at Stanford University.

BRANNERILLUS PHYSISPIRA, n.sp. Pl. VIII, Fig. 28.

? *Valvata* 'virens, Tryon', J. G. Cooper, 1894 (juvenile).

Shell as in genus.

Altitude 2.5, breadth 3.3, altitude of aperture 1.7 mm.

Pliocene: Kettleman Lake beds, California.

Kettleman Hills near Coalinga, California; marl 'reefs' near mouth of gulch south of Medallion One Cañon, east flank of Kettleman Hills (types) (H. Hannibal); marl 'reefs' at head of gulch north of Huron - Big Tar Cañon road, near Lakeview oil-well, north flank of Kettleman Hills (Dr. J. C. Merriam) (H. Hannibal).

Section 28, township 30 south, range 22 east, Telephone Hills, near McKittrick, California (R. B. Moran).

The present species, an extremely abundant one at the type locality, where it locally composes to a considerable degree the marl 'reefs' (made up chiefly of *Paludestrina longinqua*) that form so prominent an element of the topography of the east flank of the Kettleman Hills, is prevailingly carinate at this point. Elsewhere the rounded form is the more common one. The large planorboid nucleus in young specimens may have been the basis of Cooper's record of *Valvata*, which has not been verified from these beds. The two have considerable superficial resemblance.

## Superfamily VIVIPAROIDEÆ (Gray), 1857.

The Viviparoids, as at present understood, constitute two families—the Viviparidæ, a group common to both the old and new worlds, and the Lioplacidæ, at present confined to the American Province, but formerly ranging as far west as California. Several bizarre African genera customarily referred to the former group may be separable into another division upon more careful study.

## Family VIVIPARIDÆ, Gray, 1857.

Shell large, averaging 25 mm. in altitude, conic-turbinate, sub-perforate or perforate, covered with a greenish, yellowish, or brownish epidermis, whorls inflated, aperture roundly ovate, and slightly retracted below, but not sinuate; animal large and viviparous, operculum annular, with a thickened margin and nuclear area, rostrum simple and pronounced, foot quadrate and not greatly produced in front of head, tentacles short and stout, the right clavate in male, branchial laminae numerous, narrow or sub-linear, and diverging at tips to form several rows, cervical lappets large and forming trough-like ducts; habitat lakes, marshes, and quiet streams.

The Viviparidæ common to Western Europe and North America belong exclusively to *Viviparus* or its sub-genus *Callina*. No member of this genus occurs in the living state within the present district, although, like the succeeding family, fossil forms indicate a greater western extension during early Tertiary times. Two *Viviparus* introduced by the Oriental labourers from Japan as an article of food are, however, an established element of the fauna of the middle California lowlands.<sup>1</sup> While commonly classed in *Paludina*, *Vivipara*, or *Viviparus* as it is variously called, an examination of the early whorls will readily show that they are not congeneric with *Viviparus viviparus* (L.). Several years ago, in describing *Vivipara Henzadensis* from India, Pilsbry<sup>2</sup> commented on certain characters which peculiarized the operculum (these appear to the writer to be common to the entire family), and proposed the sub-genus *Idiopoma* to embrace certain species from South-Eastern Asia, of which, however, this is the only one mentioned. The species is unknown to the writer, but, judging by the figure and description, doubtless groups with *Bengalensis*, Lam., *quadrata*, Gray, and *Japonica*, v. Martens. The writer would therefore extend the name to embrace the entire genus. For the section represented by *malleata*, Reeve, and *Chinensis*, Gray, in which the adolescent carina is lost early, and the shell becomes decidedly globose in the adult condition, thus superficially recalling *Callina*, the name *Cipangopaludina* is proposed.

## Genus VIVIPARUS, Montfort.

*Helix* (sp.), Linné, 1758 (*H. vivipara*, L.); '*Cochlea vivipara fasciata*' (not binomial), Geoffroy, 1767; Martini's Transl., 1767; *Nerita* (sp.), Müller, 1774 (*N. fasciata*, Müll. = *H. vivipara*, L.);

<sup>1</sup> Hannibal, *Nautilus*, xxv, p. 31, 1911.

<sup>2</sup> Proc. Philad. Acad. Sci., 1901, p. 188.

*Bulinus* (sp.), Poiret, 1801 (*H. vivipara*, L.); *Cyclostoma* (sp.), Draparnaud, 1801 (*C. achatinum*, Drap. = *H. vivipara*, L.); *Natica* (sp.), Férussac (*H. vivipara*, L.); *Viviparus*, Montfort, 1810 (*V. fluviorum*, Mont. = *H. vivipara*, L.); *Vivipara*, J. Sowerby, 1813 (emended form); *Viviparella*, Rafinesque, 1815 (emended form); *Paludina*, Lamarck, 1816 (*H. vivipara*, L.); *Tulotoma*, Haldeman, 1840 (nude name); in Binney, 1865 (*Paludina magnifica*, Conr. = *P. subpurpurea*, Say, syntonic form).

Type, *Helix vivipara*, Linné.

Sub-genus CALLINA, n.sub-gen.

*Cochlea* (sp.), Da Costa, 1778 (*Nerita vivipara*, Müll., non Linné = *Cyclostoma contectum*, Millet).

Type, *Paludina intertexta*, Say.

Named after Professor Robert Ellsworth Call, well known for his studies in this group.

Sub-genus *Callina*. Shell large, averaging 30 mm. in altitude, conic-turbinate, perforate, whorls inflated and rounded throughout development, sutures somewhat impressed, aperture rounded-ovate and slightly retracted below, outer lip not sinuate; habitat lakes, marshes, and sluggish streams.

Sub-genus *Viviparus*, s.s. Shell similar to *Callina* but smaller, averaging 25 mm. in altitude, elevated-conic, imperforate, whorls appressed and sub-carinate at the periphery in the adult, sutures not markedly impressed; *Callina* stage carried back to early adolescence; habitat lakes, marshes, and sluggish streams.

The nomenclatural vicissitudes of this genus have been discussed by authors of wider experience than the writer, and several divergent opinions have been reached. The best-known name, *Paludina*, published in the *Encyclopédie Méthodique*, and often credited to Bruguière, 1798, did not appear until the livraison of 1816 as a latinization of Lamarck's vernacular 'Paludine', 1812, hence is preceded by *Viviparus*, *Vivipara*, and *Viviparella*, all available. *Vivipara* is sometimes credited to Martini, who, in a German translation of Geoffroy's *Traité Som. Coq. Paris*, indexed '*Cochlea vivipara fasciata*' as *Vivipara fasciata*. Geoffroy did not formally accept the Linnæan nomenclature, and, as Martini's work claimed to be nothing more than a translation, it seems inconsistent to regard this accidental binomial as having the same status as the properly formed binomials of Linné, O. F. Müller, and other contemporaries, hence Sowerby must be considered the author. The absurdity of the earliest available name, *Viviparus*, needs no comment, but according to the present ruling of the International Congress there seems no sufficient excuse to avoid its use.

VIVIPARUS (CALLINA) TURNERI, n.sp. Pl. VIII, Fig. 31.

Shell large, similar in a general way to *V. contectus* of Europe, but more slender, whorls inflated and not deep, sutures well impressed, apex small and very obtuse; habitat apparently lacustrine.

Altitude 32, breadth 26, altitude of body-whorl 20 mm.

Eocene: Truckee Lake beds, Nevada.

Silver Peak Range, Nevada: Near coal-mine (type) (H. W. Turner); same locality (S. A. Knapp); 1 mile south-east of coal-mine (H. W. Turner);  $1\frac{1}{2}$  miles south-east of coal-mine (H. W. Turner).

All the material of this species examined is rather distorted by crushing, but the series examined is sufficiently large to determine the specific characters. Named after Mr. H. W. Turner, formerly of the United States Geological Survey, who obtained most of the material while mapping the Silver Peak Range.

VIVIPARUS WASHINGTONIANUS, Arnold & Hannibal, n.sp.  
Pl. VIII, Fig. 32.

Shell small, seldom over 20 mm. in altitude, similar to *V. subpurpureus* of the Gulf States, but with a decidedly elevated spire, but slightly impressed sutures, and more slender nuclear whorls. Whorls appressed, decidedly sloping, and distinctly sub-carinate at the periphery; habitat apparently lacustrine.

Altitude 20, breadth 15, altitude of aperture 12 mm.

Eocene: Local freshwater beds in Tejon formation, Washington.

Little Falls, Washington: Bluffs along Olequa Creek above shoals 2 miles north of town (type); at shoals  $1\frac{1}{2}$  miles north of town; bend a half-mile south of town (H. Hannibal).

GENUS IDIOPOMA (Pilsbry).

*Paludina* (sp.), Lamarck, 1822 (*P. Bengalensis*, Lam.); *Vivipara* (*Idiopoma*) (sp.), Pilsbry, 1901 (*V. (I.) Hensadensis*, Pilsbry).

Type, *Vivipara* (*Idiopoma*) *Hensadensis*, Pilsbry.

Sub-genus CIPANGOPALUDINA, n.sub-gen.

Type, *Paludina malleata*, Reeve.

Sub-genus *Idiopoma*, s.s. Shell of moderate size, averaging 25 mm. in altitude, elevated-conic, sub-perforate, whorls appressed and tapering, peripherally carinate from early development stages, the carina becoming sub-obsolete on the body-whorl, apex elevated and prominent, aperture ovate and slightly retracted below; habitat lakes, streams, and marshes.

Sub-genus *Cipangopaludina*. Shell similar to *Idiopoma*, but conic-turbinate, perforate, early whorls appressed and peripherally carinate, later whorls ecarinate, and inflated with impressed sutures, aperture ovate; *Idiopoma* stage passed during adolescence; habitat similar.

IDIOPOMA JAPONICA (von Martens).

*Paludina Japonica*, von Martens, 1860.

Shell large, spire broad and strongly elevated, with a small prominent apex, sutures but little impressed, whorls deep and broadly appressed, marked by spiral striae which have a tendency to be accentuated into earinations in forms from alkali waters, peripheral earina very pronounced in young stages, and becoming sub-obsolete only on the last half-whorl, axis sub-perforate, aperture higher than broad; habitat quiet streams and marshy situations.

Japan: introduced in Coast Range System.



## IDIOPOMA (CIPANGOPALUDINA) MALLEATA (Reeve).

? *Paludina lata*, von Martens, 1860; *P. malleata*, Reeve, 1863; *P. 'Japonica*, Mart.', Wm. Wood, 1892; *Vivipara 'stelmaphora*, Bgt.', Stearns, 1901; *V. 'lecythoides*, Benson', Hannibal, 1908.

Shell large and very broad, spire elevated-conic, apex large and sub-prominent, sutures impressed, whorls inflated and fairly deep, marked by four revolving lines of punctures, two above, one at, and one below the periphery, an obtuse carina in early stages which is entirely lost before the adult condition is reached, axis perforate, aperture nearly as broad as high; habitat quiet streams and marshy situations.

Japan: introduced in Coast Range System.

## Family LIOPLACIDÆ, Gill, 1871.

Shell large, averaging 25 mm. in altitude, elevated-conic, covered with a greenish or brownish epidermis, whorls more or less appressed and shouldered, aperture sinuate, operculum uniformly thin and horny, annular, but with a sub-spiral nucleus; animal small, foot large, quadrate, and produced in front of head, rostrum small, branchial laminae elongate-triangular, of equal size, and arranged in a straight row, cervical lappets not forming tubular ducts; habitat streams, less frequently lakes.

This group, even to late years included in the Viviparidæ, from which it differs in numerous details, comprises two genera, *Lioplax* and *Campeloma*, Rafinesque (+ *Ambloxis*, 'Rafinesque,' Binney, 'Melantho, Bowditch,' Binney). The family appears to be a decadent one. While fossil species are fairly numerous and indicate a distribution as far west as California in early Tertiary times, at present *Lioplax* contains only the solitary species *L. subcarinata*, Say (+ *cyclostomatiformis*, Lea), and *Campeloma* embraces but two, *decisa*, Say (+ *coarctata*, Lea, *rufum*, Hald., *subsolidum*, Anthony, *Milesi*, Lea, etc.), and *crassula*, Raf. (+ *ponderosa*, Say).

The presence of a sub-spiral nucleus to the operculum in these genera is interesting from the light it throws on the origin of concentric operculi in groups derived from sub-spirally operculate ancestors, the annular later growth appearing as an acquired character.

## Genus LIOPLAX, Troschel.

*Lymnæa* (sp.), Say, 1817 (*L. subcarinata*, Say); *Paludina* (sp.), Say, 1819 (*L. subcarinata*, Say); *Helix* (sp.), Wood, 1828 (*H. decisa*, Wood = *L. subcarinata*, Say); *Lioplax*, Troschel, 1857 (*L. subcarinata*, Say); *Haldemania*, Tryon, 1862 (*L. subcarinata*, Say).

Type, *Lymnæa subcarinata*, Say.

Shell small, averaging 20 mm. in altitude, attenuate-conic, sub-perforate, whorls inflated and rounded, more or less shouldered at periphery, aperture sinuate and retracted below, peristome complete; habitat lakes and streams.

## LIOPLAX ANDERSONIANA, n.sp. Pl. VIII, Fig. 33.

Shell of moderate size, similar to *L. subcarinata*, but more slender, regularly elevated-conic, sub-perforate, whorls not deep, strongly inflated, and indistinctly shouldered at periphery, aperture slightly sinuate; habitat apparently lacustrine.

Altitude 21, diameter 11, altitude of aperture 9 mm.

Eocene: local freshwater beds in Tejon formation, California.

Corral Hollow, near Tesla, California; cut along Western Pacific Railroad, one-quarter of a mile above Carnegie Pottery plant (types) (H. Hannibal); same locality (Stanford University Geological Survey, per W. H. Ochsner); mouth of long gulch from north, three-quarters of a mile above Carnegie Pottery plant (Stanford University Geological Survey, per J. R. Pemberton) (H. Hannibal).

Named after Mr. Robert Anderson, of the United States Geological Survey.

## Superfamily VALVATOIDEÆ (Gray), 1840.

## Family VALVATIDÆ, Gray, 1840.

Shell small or minute, planorbiform or turbinate, umbilicate, whorls normally round, sutures impressed, aperture circular not oblique, peristome complete, operculum corneus and multispiral; animal oviparous, muzzle produced, tentacles filiform, branchiæ plumose-pectinate and exposed on right side, foot sub-quadrate and bilobed in front; habitat lakes.

The family contains but the one widespread genus, *Valvata*, of which a single protean species inhabits North America.

## Genus VALVATA, Müller.

*Valvata*, Müller, 1774 (*V. cristata*, Müll.); *Gyrorbis*, Fitzinger, 1833 (*V. cristata*, Müll.); *Planella*, Schlüter, 1838 (*V. cristata*, Müll.); *Planorbitina*, Betta, 1868 (*V. cristata*, Müll.).

Type, *Valvata cristata*, Müller.

## Sub-genus TROPIDINA, H. &amp; A. Adams.

*Cyclostoma* (sp.), Say, 1819 (*C. tricarinata*, Say); *Tropidina*, H. & A. Adams, 1854 (*C. tricarinata*, Say); *Cincinna*, Möreh, 1863 (*V. piscinalis*, Müll.); *Valvatina*, Betta, 1868 (*V. piscinalis*, Müll.); *Jelskia*, Bourguignat, 1877 (*V. jelskii*, Crosse); *Jelskia*, Westerlund, 1886 (emended form), not *Jelskia*, Taeczanovich, 1871.

Type, *Cyclostoma tricarinata*, Say.

Sub-genus *Valvata*, s.s. Shell minute, averaging 2 mm. in breadth, planorbiform, widely umbilicate, sutures moderately impressed; habitat lakes.

Sub-genus *Tropidina*. Shell prevailingly larger than *Valvata*, s.s., averaging 4 mm. in breadth, turbinate, narrowly or moderately umbilicate, sutures deeply impressed; *Valvata* stage carried back to early adolescence; habitat lakes.

VALVATA (TROPIDINA) TRICARINATA (Say).

*Cyclostoma tricarinata*, Say, 1819 (syntonic form); *V. sincera*, Say, 1824; *V. humeralis*, Say, 1829; *V. bicarinata*, Lea, 1841 (syntonic form); *V. striata*, Lewis, 1856, not *V. striata*, Phil., 1836; *V. virens*, Tryon, 1863; *V. Lewisi*, Currier, 1868; *V. sincera*, var. *Utahensis*, Call, 1884 (syntonic form); *V. mergella*, Westerlund, 1885; *V. Lewisi*, var. *helicoidea*, Dall, 1905; *V. humeralis Californica*, Pilsbry, 1908; *V. Calli*, Hannibal, 1910 (syntonic form); *V. Whitei*, Hannibal, 1910 (syntonic form).

Shell of moderate size for group, turbinate, moderately umbilicate, whorls small, sutures well impressed; habitat lakes and larger sluggish streams.

Sporadically throughout the Nearctic Region and Mexican Province.

Quaternary: Loess of eastern States; Bonneville Lake beds, Utah; Lahontan Lake beds, Nevada; Owens Lake beds, California; Summer Lake beds, Oregon; post-Glacial deposits of Vancouver Island. Pliocene: Santa Clara and Cache Lake beds, California.

The present species is readily susceptible to syntonic influences, and as a result varies more or less in the elevation of the spire and breadth of the umbilicus. Extreme forms frequently develop, in addition, one, two, three, or more spiral keels. Upon such a form the original *tricarinata* was based. *V. sincera* represents the normal aspect.

SUMMARY AND RANGE IN TIME OF THE CALIFORNIAN FAUNA.<sup>1</sup>

O, present; K, characteristic; R, recorded from elsewhere, but not from this Province.	Early Eocene.	Late Eocene, Oligocene.	Miocene.	Pliocene.	Quaternary.	Living.
<b>UNIONOIDEÆ.</b>						
Family MARGARITANIDÆ.						
<i>Margaritana (Pseudunio) Herrei</i> , n.sp. . . . . Pl. vii, fig. 17.		K				
<i>M. margaritifera</i> (L.) . . . . . W. Coast Shells, 1910, pl. i, fig. 4.			?	?	?	O
<i>M. margaritifera falcata</i> (Gould) . . . . . <i>Alasmodon falcata</i> , Gould, Wilkes Exp. Moll., figs. 545a, b.			?	?	O	O
Family UNIONIDÆ.						
<i>Unio transpacifica</i> , Arn. & Hann., n.sp. . . . . Pl. vii, fig. 18.		K				
<i>Migranaja Condoni</i> (White) . . . . . <i>Unio Condoni</i> , White, Bull. 18 U.S.G.S., pl. ii.		K				
<i>Anodonta cygnea impura</i> (Say) . . . . . Pl. v, figs. 1, 2.			O	O	O	O
<i>A. cygnea</i> (L.) . . . . . Pl. v, figs. 3, 4.			?	O	O	O

<sup>1</sup> See note on p. 211.

	Early Eocene.	Late Eocene, Oligocene.	Miocene.	Pliocene.	Quaternary.	Living.
O, present; K, characteristic; R, recorded from elsewhere, but not from this Province.						
<i>Anodonta cygnea Beringiana</i> (Midd.) . . . . . Pl. v, figs. 5, 6.				?	?	O
<i>Gonidea</i> ( <i>Limnobasilissa</i> ) <i>angulata subangulata</i> (J. G. Cooper) <i>Margaritana subangulata</i> , Cooper, Proc. Cal. Acad., iv, pl. xiv, figs. 1-4, 1894.				O	?	
<i>G. angulata Haroldiana</i> , Dall . . . . . Pl. vi, fig. 10.					?	O
<i>G. angulata</i> (Lea) . . . . . W. Coast Shells, 1910, fig. 289.					?	O
<i>G. Hemphilli</i> , n.sp. . . . . Pl. vii, fig. 19.				K		
<i>Arnoldina dejecta</i> (Lewis) . . . . . Pl. vi, fig. 9.					O	O
CYRENOIDEÆ.						
Family SPHERIIDÆ.						
<i>Sphærium corneum</i> (L.) . . . . .			?	?	R	O
<i>S. rhomboideum</i> , Prime, Mon. Corbic., fig. 31.					R	O
<i>S. tenue</i> (Prime) . . . . . Prime, Mon. Corbic., fig. 44.					?	O
<i>S. patella</i> (Gould) . . . . . Prime, Mon. Corbic., fig. 36.					O	O
<i>S. (Amesoda) simile</i> (Say) . . . . . <i>S. striatinum</i> , Prime, Mon. Corbic., fig. 29.					O	O
<i>S. (Amesoda) Idahoense</i> , Meek . . . . . White, 3rd Ann. Rep. U.S.G.S., pl. xxxii, figs. 14, 15.	K					
<i>S. (Amesoda) Rogersi</i> , n.sp. . . . . Pl. vii, fig. 21.		K				
(? <i>S. (Amesoda) Catherinæ</i> , n.sp. . . . . Pl. vii, fig. 20.	K					
<i>S. (Amesoda) Andersonianum</i> , n.sp. . . . . Pl. vi, fig. 11.				K		
<i>Musculium lacustre</i> (Müll.) . . . . .			?	?	O	O
<i>M. Raymondi</i> , Hannibal, W. Coast Shells, pl. i, fig. 3.						
<i>M. partumcium</i> (Say) . . . . . W. Coast Shells, 1910, pl. i, fig. 5.			O	?	R	O
Family CORNEOCYCLADIDÆ.						
<i>Corneocyclas</i> ( <i>Pisidium</i> ) <i>pulchella abdita</i> (Hald.) . . . . .			?	?	O	O
<i>Pisidium abditum</i> , Prime, Mon. Corbic., fig. 72.						
<i>C. (Pisidium) Meeki</i> , n.sp. . . . . Pl. vi, fig. 12.	K					
<i>C. virginica</i> (Gmel.) . . . . . <i>P. virginicum</i> , Prime, Mon. Corbic., fig. 61.					O	O
<i>C. pulchella</i> (Jenyns) . . . . . <i>P. pulchellum</i> , Gray, 1857 ed., Turton, pl. xii, fig. 151.			?	O	O	O

	Early Eocene.	Late Eocene, Oligocene.	Miocene.	Pliocene.	Quaternary.	Living.
O, present; K, characteristic; R, recorded from elsewhere, but not from this Province.						
<i>Corneocyclas compressa</i> (Prime) . . . . .			O	O	O	O
<i>P. compressum</i> , Prime, Mon. Corbic., fig. 67.						
<i>C. rotundata</i> (Prime) . . . . .				?	O	
<i>P. rotundatum</i> , Prime, Mon. Corbic., fig. 81.						
<i>C. æquilateralis</i> (Prime) . . . . .				O	O	
<i>P. æquilaterale</i> , Prime, Mon. Corbic., fig. 66.						
<i>C. Idahoensis</i> (Roper) . . . . .				?	O	
Unfigured.						
<i>C. Tremperi</i> , n.sp. . . . .						O
Pl. vii, fig. 22.						
LYMNOIDEÆ.						
Family LYMNÆIDÆ.						
<i>Lymnæa stagnalis</i> (L.) . . . . .			?	?	O	O
Binney, L. and Fw. Sh. N. Am., ii, fig. 28.						
<i>L. auricularia</i> (L.) . . . . .			?	?	O	O
<i>L. catascopium</i> , Binney, loc. cit., fig. 81.						
<i>L. palustris</i> (Müll.) . . . . .			?	?	O	O
Binney, loc. cit., fig. 66.						
<i>L. contracosta</i> , J. G. Cooper . . . . .			K			
Not adequately figured.						
<i>L. Stearnsi</i> , Hann. . . . .			K			
<i>L. maxima</i> , Stearns, Bull. Geol. Univ. Calif., v, p. 70, fig. 1.						
<i>L. Cooperi</i> , n.sp. . . . .						O
Pl. vi, fig. 13.						
<i>L. (Galba) truncatula</i> (Müll.) . . . . .			O	?	O	O
<i>L. humilis</i> , Binney, L. and Fw. Sh. N. Am., ii, fig. 99.						
<i>L. (Galba) obrussa</i> (Say) . . . . .					O	O
Binney, loc. cit., fig. 69.						
<i>L. (Galba) solida</i> , Lea . . . . .					O	O
Lea, Trans. Am. Phil. Soc., vi, pl. xxiii, fig. 91, 1838						
<i>L. (Galba) solida Cubensis</i> (Pfr.) . . . . .					?	O
<i>L. Cubensis</i> , Hannibal, W. Coast Shells, 1910, pl. iii, fig. 4.						
Family ANCYLIDÆ.						
<i>Gundlachia (Kincaidilla) fragilis</i> (Tryon) . . . . .						O
<i>Ancylus fragilis</i> , Hannibal, W. Coast Shells, 1910, pl. ii, fig. 2.						
<i>Lanx (Walkerola) Klamathensis</i> , n.sp. . . . .					O	O
Pl. viii, fig. 25.						
<i>L. Nuttalli</i> (Hald.) . . . . .						O
<i>A. Kootaniensis</i> , Binney, L. and Fw. Sh. N. Am., ii, fig. 242.						
<i>L. patelloides</i> (Lea) . . . . .						O
<i>A. patelloides</i> , Hannibal, W. Coast Shells, 1910, pl. ii, fig. 1.						

O, present; K, characteristic; R, recorded from elsewhere, but not from this Province.	Early Eocene.	Late Eocene, Oligocene.	Miocene.	Pliocene.	Quaternary.	Living.
<i>Lana subrotundatus</i> (Tryon) . . . . . Not adequately figured.						O
<i>Lavaper</i> ( <i>Ferrisia</i> ) <i>caurinus</i> (W. Cooper) . . . <i>A. caurinus</i> , W. Cooper in Binney, L. and Fw. Sh. N. Am., ii, fig. 243.					?	O
(? <i>L.</i> ( <i>Ferrisia</i> )) <i>undulatus</i> (Meek) . . . . . <i>A. undulatus</i> , White, 3rd Ann. Rep. U.S.G.S., pl. xxxii, fig. 10.	K					
(? <i>Neoplanorbis</i> ( <i>Amphigyra</i> )) <i>Dalli</i> (White) . . . <i>Latia Dalli</i> , White, loc. cit., pl. xxxii, figs. 37-40.	K					
<i>Fisherola laevides</i> , n.sp. . . . . Pl. viii, fig. 35.						O
<i>Zalophaneylus Morani</i> , n.sp. . . . . Pl. vi, fig. 15.				K		
Family PLANORBIDÆ.						
<i>Planorbis</i> ( <i>Gyraulus</i> ) <i>albus</i> , Müll. . . . . Binney, L. and Fw. Sh. N. Am., ii, fig. 220.			?	?	R	O
<i>P.</i> ( <i>Gyraulus</i> ) <i>parrus</i> , Say . . . . . W. Coast Shells, 1910, pl. ii, fig. 11.					O	O
<i>P.</i> ( <i>Gyraulus</i> ) <i>Liebmanni</i> , Dunker . . . . . Binney, L. and Fw. Sh. N. Am., ii, figs. 182, 183.					O	O
<i>P.</i> ( <i>Gyraulus</i> ) <i>filocinetus</i> , P. & F. . . . . Pilsbry & Ferriss, Proc. Philad. Acad., 1906, pl. ix, figs. 1-3.						O
<i>P.</i> ( <i>Segmentina</i> ) <i>armigerus</i> , Say . . . . . Gould, Invert. Mass., 1841, fig. 138.					?	O
<i>P.</i> ( <i>Segmentina</i> ) <i>Mojavensis</i> , n.sp. . . . . Pl. viii, fig. 24.			K			
<i>P.</i> ( <i>Hippeutis</i> ) <i>exacutus</i> , Say . . . . . <i>P. exacutus</i> , Gould, Invert. Mass., 1841, fig. 137.					O	O
<i>P.</i> ( <i>Hippeutis</i> ) <i>dilatatus</i> , Gould . . . . . <i>P.</i> var. <i>centervillensis</i> , Hannibal, W. Coast Shells, 1910, pl. ii, fig. 9.				O	O	O
<i>Helisoma</i> ( <i>Planorbella</i> ) <i>trivolis</i> (Say) . . . . . <i>Planorbis trivolis</i> , Hannibal, loc. cit., figs. 292, 293.				O	O	O
<i>H. antrosa</i> (Conrad) . . . . . <i>P. bicarinatus</i> , Binney, L. and Fw. Sh. N. Am., ii, fig. 205.					R	O
<i>H.</i> ( <i>Perrinilla</i> ) <i>pabloana</i> (J. G. Cooper) . . . . . Not adequately figured.			K			
<i>H.</i> ( <i>Perrinilla</i> ) <i>Cordillerana</i> , n.sp. . . . . Pl. vi, fig. 16; pl. viii, fig. 34.	K					
Family POMPHOLIDÆ.						
<i>Pompholyx effusa</i> , Lea . . . . . W. Coast Shells, 1910, pl. ii, fig. 4.				O	O	O



O, present; K, characteristic; R, recorded from elsewhere, but not from this Province.	Early Eocene.	Late Eocene, Oligocene.	Miocene.	Pliocene.	Quaternary.	Living.
<i>Pompholyx (Carinifex) Newberryi</i> (Lea) . . . . . <i>Carinifex Newberryi</i> , Binney, L. & Fw. Sh. N. Am., ii, fig. 120.					O	O
<i>P. (Carinifex) Binneyi</i> (Meek) . . . . . <i>C. Binneyi</i> , White, 3rd Ann. Rep. U.S.G.S., pl. xxxii, figs. 5-9.	K					
<i>P. (Carinifex) sanctæclaræ</i> (Hann.) . . . . . Pl. vi, fig. 14.				K		
Family PHYSIDÆ.						
<i>Physa fontinalis</i> (L.) . . . . . <i>P. heterostropha</i> , Binney, L. and Fw. Sh. N. Am., ii, fig. 144.			?	?	O	O
<i>P. fontinalis acuta</i> (Drap.) . . . . . <i>P. osculans</i> , Binney, loc. cit., fig. 146.			?	O	O	O
<i>P. hypnorum</i> (L.) . . . . . <i>Aplexa hypnorum</i> , Hannibal, W. Coast Shells, 1910, fig. 296.			?	?	?	O
MELANOIDEÆ.						
Family PLEUROCERIDÆ.						
<i>Ambloxyx pliciferus</i> (Lea) . . . . . W. Coast Shells, 1910, pl. iii, fig. 10 (normal), fig. 9; text-fig. 297.				O	O	O
<i>A. tenerus</i> (Hall) . . . . . (Eocene Goniobases), White, 3rd Ann. Rep. U.S.G.S., pl. xxxi, figs. 1-30.	K					
<i>A. Olequaensis</i> , Arn. & Hann., n.sp. . . . . Pl. viii, fig. 27.		K				
Family MELANOPSIDÆ.						
<i>(? Pachychilus) Taylora</i> (Gabb) . . . . . <i>Melania Taylora</i> , White, 3rd Ann. Rep. U.S.G.S., pl. xxxii, fig. 3.	K					
<i>(? P.) Lawsoni</i> , n.sp. . . . . Pl. viii, fig. 23.			K			
<i>(? P.) Drakei</i> , Arn. & Hann., n.sp. . . . . Pl. viii, fig. 26.		K				
RISSEOIDEÆ.						
Family AMNICOLIDÆ.						
<i>Amnicola limosa</i> (Say) . . . . . Binney, L. and Fw. Sh. N. Am., iii, fig. 166.					O	O
<i>A. micrococcus</i> , Pilsbry . . . . . Stearns, Proc. U.S. Nat. Mus., xxiv, p. 286, fig. 4.						O
<i>Paludestrina protea</i> (Gould) . . . . . Stearns, loc. cit., pls. xix-xxi.				O	O	O
<i>P. longinqua</i> (Gould) . . . . . Stearns, loc. cit., p. 285, fig. 2.				O	O	O

O, present; K, characteristic; R, recorded from elsewhere, but not from this Province.	Early Eocene.	Late Eocene, Oligocene.	Miocene.	Pliocene.	Quaternary.	Living.
<i>Fluminicola virens</i> (Lea) . . . . . W. Coast Shells, 1910, fig. 299.						O
<i>F. Modoci</i> , n.sp. . . . . Pl. viii, fig. 30.						O
<i>F. (Heathilla) fusca</i> (Hald.) . . . . . W. Coast Shells, 1910, fig. 298.					O	O
<i>F. (Heathilla) seminalis</i> (Hinds) . . . . . Loc. cit., pl. iii, fig. 12.						O
<i>F. (Heathilla) Merriami</i> , Pils. & Beech . . . . . Stearns, Proc. U.S. Nat. Mus., xxiv, p. 286, fig. 5.						O
<i>F. (Heathilla) erythropoma</i> , Pils. . . . . Unfigured.						O
<i>F. (Heathilla) Columbiana</i> , Pils. . . . . Unfigured.						O
<i>F. (Heathilla) minutissima</i> , Pils. . . . . Unfigured.						O
(? <i>Pyrgulopsis</i> ) <i>antiqua</i> (Gabb) . . . . . <i>Lithasia antiqua</i> , White, 3rd Ann. Rep. U.S.G.S., pl. xxxii, fig. 4.	K					
<i>P. Nevadensis</i> (Stearns) . . . . . Call & Pilsbry, Proc. Davenport Acad., v, 1886, pl. ii, figs. 1-10.					O	O
<i>P. Yatesiana</i> (J. G. Cooper) . . . . . <i>Ammicola Yatesiana</i> , Cooper, Proc. Cal. Acad., iv, pl. xiv, fig. 10, 1894.				K		
<i>P. Williamsi</i> , n.sp. . . . . Pl. viii, fig. 29.				K		
<i>Cincinnatia Cincinnatiensis</i> (Anth.) . . . . . <i>A. Cincinnatiensis</i> , Dall, Alaska, xiii, fig. 87.					O	O
<i>Brammerillus physispira</i> , n.sp. . . . . Pl. viii, fig. 28				K		
VIVIPAROIDEÆ.						
Family VIVIPARIDÆ.						
<i>Viviparus (Callina) Turneri</i> , n.sp. . . . . Pl. viii, fig. 31.	K					
<i>V. Washingtonianus</i> , Arn. & Hann., n.sp. . . . . Pl. viii, fig. 32.		K				
<i>Idiopoma Japonica</i> (v. Mart.) . . . . . <i>Viviparus Japonicus</i> , Pilsbry, Proc. Philad. Acad., 1902, pl. ix, fig. 1.						I
<i>I. (Cipangopaludina) malleata</i> (Reeve) . . . . . <i>Vivipara malleatus</i> , Hannibal, W. Coast Shells, 1910, pl. iii, fig. 8.						I
VALVATOIDEÆ.						
Family VALVATIDÆ.						
<i>Valvata (Tropidina) tricarinata</i> (Say) . . . . . <i>V. humeralis</i> , Hannibal, W. Coast Shells, 1910, pl. ii, fig. 6.				O	O	O

GEOGRAPHIC DISTRIBUTION OF THE LIVING CALIFORNIAN FAUNA.

	Yukon.	Alaska.	Fraser.	Columbia.	Klamath.	Utah.	Nevada.	Coast Range.	Mojave.	Los Angeles.	Colorado.	Arizona.	American.	Extra-limital Provinces.		
														Northern Europe.	Eastern Siberia.	Mexican.
<p>O, regularly present; L, local;                      I, introduced; S, sporadic;                      X, extinct; K, characteristic.</p>																
<b>UNIONOIDEÆ.</b>																
Family MARGARITANIDÆ.																
<i>Margaritana margaritifera</i> (L.) . . . . .			S	S	S	S	S	S					O		O	
<i>M. margaritifera falcata</i> (Gld.) . . . . .			O	O	O	O	O	L					L		O	
Family UNIONIDÆ.																
<i>Unionida cygnea impura</i> (Say) . . . . .				S	S	O	O	O	O	O	O	O				
<i>U. cygnea</i> (L.) . . . . .	S	S	O	O	O	S	S	S		I					O	
<i>U. cygnea Beringiana</i> (Midd.) . . . . .	O	O	O	S												
<i>Unionida angulata Haroldiana</i> , Dall. . . . .				S	S	S		S		S						
<i>U. angulata</i> (Lea) . . . . .				O	O	O		O		O						
<i>Unionida dejecta</i> (Lewis) . . . . .												L				
<b>CYRENOIDEÆ.</b>																
Family SPHERIIDÆ.																
<i>Sphaerium corneum</i> (L.) . . . . .	S	?	S	S									S		S	
<i>S. tenue</i> (Prime) . . . . .	S	?	?	S		S							S			
<i>S. patella</i> (Gld.) . . . . .				S									S			
<i>S. (Amesoda) simile</i> (Say) . . . . .				O	O	O	O	O	O		O	O	O			
<i>Sphaerium lacustre</i> (Müll.) . . . . .				S	S	S	?	?	S	S		?	S	S	S	
<i>S. ovale</i> (Fér.) . . . . .												?	S	S	S	
<i>S. partumeium</i> (Say) . . . . .				?	S	?	?	S					S			
Family CORNEOCYCLADIDÆ.																
<i>Corneocyclas (Pisidium) pulchella</i> <i>abdita</i> (Hald.) . . . . .	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	
<i>C. Virginica</i> (Gmel.) . . . . .	S												S			
<i>C. pulchella</i> (Jenyns) . . . . .	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	
<i>C. compressa</i> (Prime) . . . . .	S	?	S	S	S	?	S	S	?	L	S	S	S	S		
<i>C. rotundata</i> (Prime) . . . . .	S												S			
<i>C. æquilateralis</i> (Prime) . . . . .	S												S		S	
<i>C. Idahoensis</i> (Roper) . . . . .	S	?	S	S									S			
<i>C. Tremperi</i> , n.sp. . . . .									K							
<b>LYMNOIDEÆ.</b>																
Family LYMNÆIDÆ.																
<i>Lymnaea stagnalis</i> (L.) . . . . .	O	O	O	O	O	O	O	L					O	O	O	
<i>L. auricularia</i> (L.) . . . . .	O	O	O	L	O	O							O	O	O	
<i>L. palustris</i> (Müll.) . . . . .	O	O	O	O	O	O	O	O	O	O			O	O	O	
<i>L. Cooperi</i> , n.sp. . . . .									K							
<i>L. (Galba) truncatula</i> (Müll.) . . . . .	O	O	O	O	O	O	O	O	O	O	O	O	O	O	L	
<i>L. (Galba) obrussa</i> (Say) . . . . .				O	O	O							O			
<i>L. (Galba) solida</i> , Lea . . . . .	O	O	O	O	O	O	O	O		S		L				
<i>L. (Galba) solida Cubensis</i> (Pfr.) . . . . .				S	S	O	O	O	O	O	O	O			O	

	Yukon.	Alaska.	Fraser.	Columbia.	Klamath.	Utth.	Nevada.	Const Range.	Mojave.	Los Angeles.	Colorado.	Arizona.	American.	Extra-limi Provinces	
														Northern Europe.	Eastern Siberia.
O, regularly present; L, local; I, introduced; S, sporadic; X, extinct; K, characteristic.															
Family ANCYLIDÆ.															
<i>Gundlachia (Kincaidilla) fragilis</i> (Tryon)									K						
<i>Lanx (Walkerola) Klamathensis</i> , n.sp.					KL										
<i>L. Nuttallii</i> (Hald.) . . . . .				KL											
<i>L. patelloides</i> (Lea) . . . . .					KL										
<i>L. subrotundatus</i> (Tryon) . . . . .					KL										
<i>Lævapex (Ferrissia) caurinus</i> (W. Cooper)			O	O	O	O	O								
<i>Fisherola lancides</i> , n.sp. . . . .					KL										
Family PLANORBIDÆ.															
<i>Planorbis (Gyraulus) albus</i> , Müll.	S	S	S	S	S	?		L					O	O	O
<i>P. (Gyraulus) parvus</i> , Say . . . . .	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
<i>P. (Gyraulus) Liebmanni</i> , Dunker												S			
<i>P. (Gyraulus) filocinctus</i> , Pils. & Fér.												O			
<i>P. (Segmentina) armigerus</i> , Say	S												O		
<i>P. (Hippentis) exacutus</i> , Say . . . . .	S	?	S	L									O		
<i>P. (Hippentis) dilatatus</i> , Gould . . . . .	O	O	O	O	O	O	O	O	O	O	O	O	O	L	
<i>Helisoma (Planorbella) trivolvis</i> (Say)	O	O	O	O	O	O	O	O	O	O	O	O	O		
<i>H. antrosa</i> (Conrad) . . . . .			S	S									O		
Family POMPLOGIDÆ.															
<i>Pompholyx effusa</i> , Lea . . . . .				S	O	S	S	L	S						
<i>P. (Carinifex) Newberryi</i> (Lea) . . . . .					O		S	L	L						
Family PHYSIDÆ.															
<i>Physa fontinalis</i> (L.) . . . . .	O	O	O	O	O	O	O	O	S		S		O	O	O
<i>P. fontinalis acuta</i> (Drap.) . . . . .					S	S	S	O	O	O	O	O	O	O	O
<i>P. hypnorum</i> (L.) . . . . .	O			L		O							O	O	O
MELANOIDEÆ.															
Family PLEUROCIDÆ.															
<i>Ambloxus pliciferus</i> (Lea) . . . . .			L	O	O		L	L							
RISSOIDEÆ.															
Family AMNICOLIDÆ.															
<i>Amnicola limosa</i> (Say) . . . . .						S							O		
<i>A. micrococcus</i> , Pils. . . . .									K						
<i>Paludestrina protea</i> (Gld.) . . . . .				S	X	S	S	X	S	X	?	S			
<i>P. longinqua</i> (Gld.) . . . . .				L		O	O	O	O	O	?	O			
<i>Fluminicola virens</i> (Lea) . . . . .			L	K											
<i>F. Modoci</i> , n.sp. . . . .															
<i>F. (Heathilla) fusca</i> (Hald.) . . . . .						KL									
<i>F. (Heathilla) seminalis</i> (Hinds)					O		O								
<i>F. (Heathilla) Merriami</i> , Pils. & Behr.									K						

O, regularly present ; L, local ; I, introduced ; S, sporadic ; X, extinct ; K, characteristic.	Yukon.	Alaska.	Fraser.	Columbia.	Klamath.	Utah.	Nevada.	Coast Range.	Mojave.	Los Angeles.	Colorado.	Arizona.	American.	Extra-limital Provinces.		
														Northern Europe.	Eastern Siberia.	Mexican.
<i>Limnicola (Heathilla) erythropoma</i> , Pils. ( <i>Heathilla</i> ) <i>Columbiana</i> , Pils. ( <i>Heathilla</i> ) <i>minutissima</i> , Pils. <i>Argulopsis Nevadaensis</i> (Stearns) <i>incinnatia Cincinnatiensis</i> (Anth.)				KL KL		S	K		K				O			
VIVIPAROIDEÆ.																
Family VIVIPARIDÆ.																
<i>Limnopoma Japonica</i> (v. Mart.) ( <i>Cipangopaludina</i> ) <i>malleata</i> (Reeve)									I I							O O
VALVATOIDEÆ.																
Family VALVATIDÆ.																
<i>Valvata tricarinata</i> (Say)	S	S	S	S	S	S	S	S	S	?	S	?	S			S

*Pelecypoda*, 23 ; *Gastropoda*, 47 ; total, 70 species and sub-species.

CONCLUDING REMARKS.

While it has been held as brief that unnecessary confusion of the literature should be avoided by the introduction of as few innovations of nomenclature as possible, the fact has not been overlooked that unless some standard code be followed the endeavours of that corps of specialists whose work can only be compared with the wrecking-crew on one of our railroads would shortly render the bulk of the data in these pages wellnigh useless to the lay reader. The problem is less a matter of the retention of certain old names which have been more or less current in the literature, for both consistency and common sense prohibit their use where they have been rendered futile by the application of the genetic classification ; rather it resolves itself into permitting the establishment of unfamiliar names for a species several times successively, or establishing one once and, let it be hoped, for all time.

Under the circumstances the writer has given as much care to the selection of the names to be used for the species as in determining their limits and relationships, and only lack of the necessary literature has prevented even more extensive revisions. The provisions and recommendations of the International Code have ordinarily been accepted in deciding upon the validity of names. The frequency that these do not cover the questions at issue has led to the adoption of several additional rules, the more important of which may be noted. The numbers apply to the sections of the Code affected.

IV. The name of a superfamily is formed by adding the ending *oidea*<sup>1</sup> to the stem of the name of its type genus. Family, subfamily, and superfamily names are subject to the law of priority, and from a nomenclatural standpoint may be regarded as co-ordinate and interchangeable.

XXI. In the instance of a name published by one writer and attributed to another, and it is not clear from the context which author is responsible for the accompanying description, definition, or indication, the publishing author shall be held responsible for the name in all instances except (a) where it had been previously used as a *nomen nudum* by the author to whom it is attributed, or (b) it is subsequently claimed by the latter author in another publication.

XXV (b). Generic names, whether accompanied by a definition or not, under which no species or merely manuscript species are cited or indicated (excluding as a matter of course instances where the diagnosis of a species and genus are given as one), are not formed in accordance with the fundamentals of binomial nomenclature, and have no status under the Code. Such names take status only when reintroduced in the proper manner and from the time of reintroduction.<sup>2</sup>

XXX (iii). If a genus without a definitely designated type contains as an available species one which has been repeatedly mentioned as an illustration, example, or characteristic representative of the genus, said species shall be virtually regarded as type by subsequent designation.

#### PRINCIPAL LITERATURE.

Except in a few instances figures, references, or discussions of the species recognized in the preceding pages may be found in the following papers. It is the intention of the writer to supplement this article with detailed studies of each group, amply illustrated, as rapidly as possible.

#### GENERAL PAPERS.

DALL, W. H. *Land and Freshwater Mollusks of Alaska and adjoining Regions* (Harriman Alaska Expedition, xiii, 1905, pp. 171, 3 plates, and many text-cuts).

An indispensable handbook covering the district north of the 49th parallel. The treatment of the Lymnæidæ and other groups whose metropolis is essentially boreal is far superior to that of any other writer.

HANNIBAL, H. "Shells of Lakes and Streams," in Keep, *West Coast Shells* (revised edition), December, 1910, pp. 299-318, 3 plates, and several text-cuts.

<sup>1</sup> T. Gill, Smith. Report for 1896, 1898, p. 480. The termination *oidea*, first suggested in this connexion, is preoccupied by its use as a generic ending, cf. *Cyrenoidea*. *Acea* has appeared in one or two papers, but was originally applied by the Adams as an ordinal termination, and must be suppressed for a group of different rank. There is no apparent reason why it should have been replaced by the current miscellany of names, which furnish a clue to the groups they embrace to the specialist only.

<sup>2</sup> The necessity of this rule in dealing with the Brünnichian and Rafinesquian genera (and some others) is obvious.



Figures and brief accounts of about forty of the more common or peculiar species inhabiting the United States west of the Rocky Mountains. It should be recalled that *Lymnaea obrussa* and *Amnicola micrococcus* as described and figured here are now referred to *L. Cooperi*, n.sp., and *Fluminicola Modoci*, n.sp., respectively.

## UNIONOIDEÆ.

SIMPSON, C. T. "Synopsis of the Naiades, or pearly freshwater Mussels": Proc. U.S. Nat. Mus., xxii, No. 1205, pp. 501-1044, 1 plate, 1900.

## CYRENOIDEÆ.

PRIME, T. *Monograph of American Corbiculadæ* (Smith. Misc. Coll., No. 145), 1865, pp. 80, many text-cuts.

Written many years ago, but still a standard.

DALL, W. H. [Sphæriidæ] in "Contributions to the Tertiary Fauna of Florida, etc.": Trans. Wagn. Inst., vol. iii (6), pp. 1455-64, 1903.

An excellent revision of the generic classification.

## LYMNOIDEÆ.

BINNEY, W. G. *Land and Freshwater Shells of North America*. Part ii: Pulmonata, Linnophila, and Thalassophila (Smith. Misc. Coll., No. 143), 1865, pp. 120, many text-cuts.

A classical work.

## MELANOIDEÆ.

TRYON, G. W. J. *Land and Freshwater Shells of North America*. Part iv: Strepomatidæ (Smith. Misc. Coll., No. 253), 1873, pp. 435, many text-figures.

PILSBRY, H. A. [Notes on the Pleuroceridæ] in Pilsbry & Rhodes, "Contributions to the Zoology of Tennessee," No. 4, Mollusks: Proc. Philad. Acad. Sci., 1896, pp. 495-7.

## RISSEOIDEÆ, VIVIPAROIDEÆ, AND VALVATOIDEÆ.

STIMPSON, W. M. *Researches upon the Hydrobiinæ and allied forms* (Smith. Misc. Coll., No. 201), 1865, pp. 59, and several text-figures.

An excellent account of the anatomical characters of the then known genera of Amnicolidæ.

BINNEY, W. G. *Land and Freshwater Shells of North America*. Part iii [Operculates except Melanoids] (Smith. Misc. Coll., No. 144), 1865, pp. 120, and many text-cuts.

As valuable as the preceding parts of this series by the same writer.

DALL, W. H. [Viviparidæ] in "Contributions to the Tertiary Fauna of Florida, etc.": Trans. Wagn. Inst., vol. iii (2), pp. 332-5, 1892.

PILSBRY, H. A. "Catalogue of the Amnicolidæ of the Western United States": *Nautilus*, xii, pp. 121-7, 1899.

Brief, but the best treatment of the local species of this difficult group extant.

PILSBRY, H. A. "Revision of Japanese Viviparidæ, etc.": Proc. Philad. Acad. Sci., 1902, pp. 115-21, pl. ix.

## PALÆOMALACOLOGY.

WHITE, C. A. "Review of the Non-marine Fossil Mollusca of North America": 3rd Ann. Rep. U.S. Geol. Surv., 1883, pp. 403-550, 32 plates.

Contains notices and figures of all the species described to 1882.

CALL, R. E. "On the Quaternary and Recent Mollusca of the Great Basin, with descriptions of new forms": Bull. 11, U.S. Geol. Surv., pp. 66, 6 plates, 1884.

WHITE, C. A. "On marine Eocene, freshwater Miocene, and other Fossil Mollusca from Western North America": Bull. 18, U.S. Geol. Surv., pp. 26, 3 plates, 1885.

COOPER, J. G. "On some Pliocene Freshwater Fossils of California": Proc. Calif. Acad. Sci., ser. II, iv, pp. 164-72, pl. xiv, 1894.

STEARNS, R. E. C. "The Fossil Freshwater Shells of the Colorado Desert, their distribution, environment, and variation": Proc. U.S. Nat. Mus., xxiv, No. 1256, pp. 271-99, pls. xix-xxiv, 1902.

#### NEW GROUPS PROPOSED IN THIS PAPER.

Those preceded by a † are proposed on fossil forms.

#### UNIONOIDEÆ.

Quadralidæ, sub-family Pleurobeminæ, n. sub-fam.

Lampsilidæ, sub-family Propterinae, n. sub-fam.

*Migranaja*, n. gen. (*Unio littoralis*, Lam.).

*Arnoldina*, n. gen. (*Anodonta dejecta*, Lewis).

† *Gonidea*, sub-gen. *Limnobasilissa*, n. sub-gen. (*Margaritana subangulata*, J. G. Cooper).

† *Margaritana* (*Pseudunio*) *Herrei*, sp. nov.

† *Unio trauapacificæ*, Arnold & Hannibal, n. sp.

† *Gonidea Hemphilli*, n. sp.

#### CYRENOIDEÆ.

Corneocycladidæ, n. n. (Pisidiadæ, Gray, not available).

† *Sphærium* (*Amesoda*) *Rogersi*, n. sp.

† *S.* (*Amesoda*) *Andersonianum*, n. sp.

† *S.* (*Amesoda*) *Catherinæ*, n. sp.

† *Corneocyclas* (*Pisidium*) *Meeki*, n. sp.

*C. Tremperi*, n. sp.

#### LYMNOIDEÆ.

Lymnæidæ, sub-family Acellinæ, n. sub-fam.

Ancylidæ, sub-family Lævapecinæ, n. sub-fam.

Ancylidæ, sub-family Latiinæ, n. sub-fam.

Ancylidæ, sub-family Neoplanorbinæ, n. sub-fam.

*Fisherola laucides*, n. gen. et n. sp.

† *Zalophanicylus Morani*, n. gen. et n. sp.

*Lauræ*, sub-gen. *Walkerola*, n. sub-gen. (*L.* (*Walkerola*) *Klamathensis*, n. sp.).

*Gundlachia*, sub-gen. *Kincaidilla*, n. sub-gen. (*Ancylus fragilis*, Tryon).

† *Helisoma*, sub-gen. *Perrinilla*, n. sub-gen. (*H.* (*Perrinilla*) *Cordillerana*, n. sp.).

† *Planorbis* (*Segmentina*) *Mojarensis*, n. sp.

*Lymnæa Cooperi*, n. sp.

#### MELANOIDEÆ.

Ellipstomidæ, n. fam.

Pleuroceridæ, sub-family Gyrotominæ, n. sub-fam.

† *Ambloxus Olequaensis*, Arnold & Hannibal, n. sp.

† *Pachychilus Lawsoni*, n. sp.

† *P. Drakei*, Arnold & Hannibal, n. sp.

#### RISSEOIDEÆ.

Bulimidæ, n. n. (Bythiniidæ, Tryon, not available).

† *Brannerillus physispirus*, n. gen. et n. sp.

*Fluminicola*, sub-gen. *Heathilla*, n.sub-gen. (*Paludina seminalis*, Hinds).

*F. Modoci*, n.sp.

† *Pyrgulopsis Williamsi*, n.sp.

*Cincinnatia Binneyana*, n.n. (*Paludina obtusa*, Lea, preoccupied).

#### VIVIPAROIDEÆ.

*Viviparus*, sub-gen. *Callina*, n.sub-gen. (*Paludina intertexta*, Say).

*Idiopoma*, sub-gen. *Cipangopaludina*, n.sub-gen. (*Paludina malleata*, Reeve).

† *Viviparus* (*Callina*) *Turneri*, n.sp.

† *V. Washingtonianus*, Arnold & Hannibal, n.sp.

† *Lioplax Andersoniana*, n.sp.

#### EXPLANATION OF PLATES V-VIII.

With the exception of the *Anodontas* and *Arnoldina* the species illustrated are new or figured for the first time. Characteristic figures of these four have been added owing to the prevailing uncertainty of their identity. Unless the contrary is stated, figures are approximately natural size.

Plates V and VI are reproduced from photographs taken by Mr. John Howard Paine, of Stanford University; Plates VII and VIII from photographs by the writer, through the courtesy of Professor Trevor Kincaid.

#### PLATE V.

(Issued in Part II.)

1. *Anodonta cygnea impura* (Say). Pond, Elysian Park, Los Angeles, California. p. 125.
2. *A. cygnea impura* (Say) (juvenile). Coyote River, Artesian Belt near San José, California. p. 125.
3. *A. cygnea* (L.). Dalles, Oregon. p. 125.
4. *A. cygnea* (L.) (juvenile). Umpqua River, Elkton, Oregon. p. 125. The individual is just past the *impura* stage at this side. *Cygnea* shows almost unlimited variation in this respect, however.
5. *A. cygnea Beringiana* (Midd.). Lake Hicaman, Alaska. p. 125.
6. *A. cygnea Beringiana* (Midd.) (juvenile). Narrows between Beaver and Alexander Lakes, Admiralty Islands, Alaska. p. 125. The specimen is barely past the *cygnea* stage.
7. *A. cygnea impura* (Say).  $\times \frac{3}{2}$ . Uvas River, Gilroy, California. p. 125. Collected in July, probably about three months from the glochidium. All three sub-species are ordinarily identical at this size.
8. *A. cygnea* (L.). Glochidium, length 0.35, altitude 0.35 mm. North-east shore of Rhett Lake, near California-Oregon boundary. p. 125.

#### PLATE VI.

(Issued in Part II.)

9. *Arnoldina dejecta* (Lewis). San Bernardino Rancho, Arizona-Mexico boundary. p. 129.
10. *Gonidea angulata Haroldiana*, Dall (cotype). Coyote Creek, between San José and San Francisco Bay, Artesian Belt, California. p. 127. Through a misunderstanding the original locality was given by Dall as the Guadeloupe Creek. The species formerly occurred there, but was destroyed by sewage about two or three years previous to the time collections sent to the National Museum were made. The variety is not always as large or finely developed as the figure would indicate, but exhibits more or less local variation in this respect.